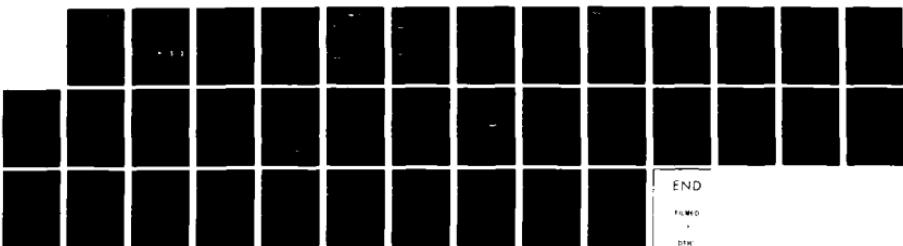


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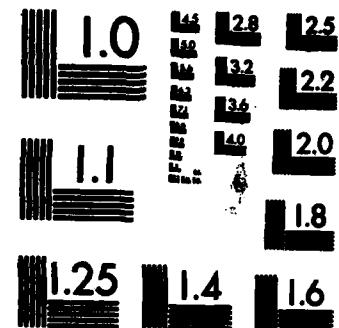
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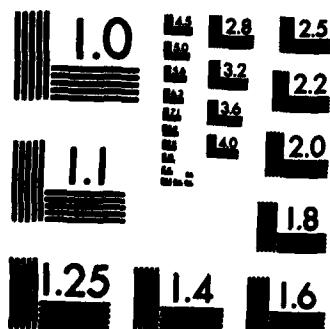
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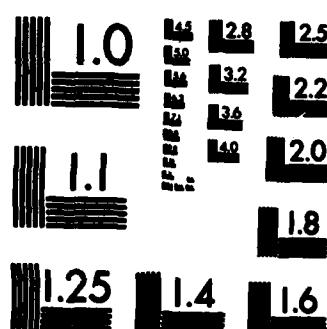
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**EUROPEAN SCIENTIFIC NOTES  
OFFICE OF NAVAL RESEARCH  
LONDON**

edited by Donald R. Barr and Don J. Peters

31 July 1982

Volume 36, No. 7

**BEHAVIORAL  
SCIENCES**

**A Human Body Vibration Display**  
A new Danish instrument  
senses the prevailing vibration  
state in the environment and  
displays the human factors  
implications of that environ-  
ment.

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**Visibility Problems in Jet Aircraft**  
Window posts and empty-field  
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**CHEMISTRY**

**European Chemical Conference on Molten  
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The discussions relating to  
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**Coastal Problems and the Mediterranean  
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The problems of flooding,  
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works, hierarchical processing  
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digital signal processing are  
touched upon. Session head-  
ings are also listed, and  
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**Optical Communication Research in Scandinavian Universities**

The high number of telephones per capita and geographical features that pose special problems to communication have stimulated high-quality optical-fiber research in Scandinavian universities.

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**MATERIAL SCIENCES**

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An overview is given of current materials research at five Swiss research centers including the Federal Institute of Technology at Zurich and Lausanne, the University of Neuchâtel, Battelle - Geneva, and Brown Boveri and Co. Ltd.

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Mathematical methods for solving systems of equations related to control problems, development of mathematical models for various physical systems, and specific applications to operating systems were the main topics of interest.

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**The International Meeting on Analysis of Sample Survey Data and on Sequential Analysis**

Joint and parallel sessions on sample survey data and on sequential analysis were held during this week-long meeting.

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Among the possible new starts under consideration by the European Space Agency is the Kepler mission to Mars.

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**European X-ray Astronomy**

The European Space Agency will launch its first satellite dedicated to X-ray astronomy (EXOSAT) late this year, and the FRG is planning a mission (ROSAT) carrying a pair of telescopes operating in the soft X-ray range. These and other European missions provide European scientists with opportunities not available to US scientists.

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Polymer Chemistry  
Aerospace Systems  
Command, Control and  
Communications  
Electronics

## BEHAVIORAL SCIENCES

### A HUMAN BODY VIBRATION DISPLAY

The human body is a mechanical system that responds to mechanical forces, so theoretically it should be possible to describe the system's responses and "resonances" to vibration and also to discover when vibratory stimuli can be expected to disturb output behavior. In practice, however, the great complexity of the whole system and of its many subsystems makes this descriptive task extraordinarily difficult. Nevertheless, G. Rasmussen (Brüel and Kjaer, Naerum, Denmark) has recently assembled much of the data about human response to vibration, and he has proposed a design for a portable "vibration-meter" instrument that would incorporate the data. The instrument receives vibratory signals, processes them by means of algorithms and stored "limit" data, and displays the likely human impact of a given exposure situation. This type of device may have significant value for studying man-machine interactions. There are still military and industrial environments, for example, in which men cannot remain long without suffering performance degradation or physical illness; at least some of the negative effects observed are attributable to vibration.

Figure 1 is Rasmussen's model of a human standing on a vertically moving base. The parameters listed reflect many experimental and practical measurements. Though summary representations like the one shown are necessarily crude and would not fit any one person perfectly, it appears that there are several important resonance peaks: thoracic resonance at 3 to 6 Hz, lower arm resonance at 16 to 30 Hz, and handgrip, intracocular structures, and skull resonating at higher frequencies.

For frequencies from 1 to about 80 Hz, discomfort and exposure-limit curves have been determined and published, and these are often recommended as environmental standards for certain time periods. As one example, a "standard human" would be expected to experience discomfort if exposed to a slow (5 to 6 Hz) and heavy ( $3\text{m/s}^2$ ) vertical vibration for 1 minute, and, according to the curve in Figure 2, such discomfort would be equivalent to a 16-minute exposure at an acceleration of only a little more than  $2\text{m/s}^2$ . Exposure limits or allowed tolerances are roughly twice the discomfort accelerations, so it is common design practice to keep the effective vibration below the discomfort levels; this is especially true if critical motor or cognitive behaviors are demanded of the exposed human subject.

The tolerance-curve approach has been applied to estimating the human effects of pulses such as those from pile drivers, drop forges, heavy conveyors, and the rumble of trains over flexible platforms. According to Figure 3 on the following page, compiled by

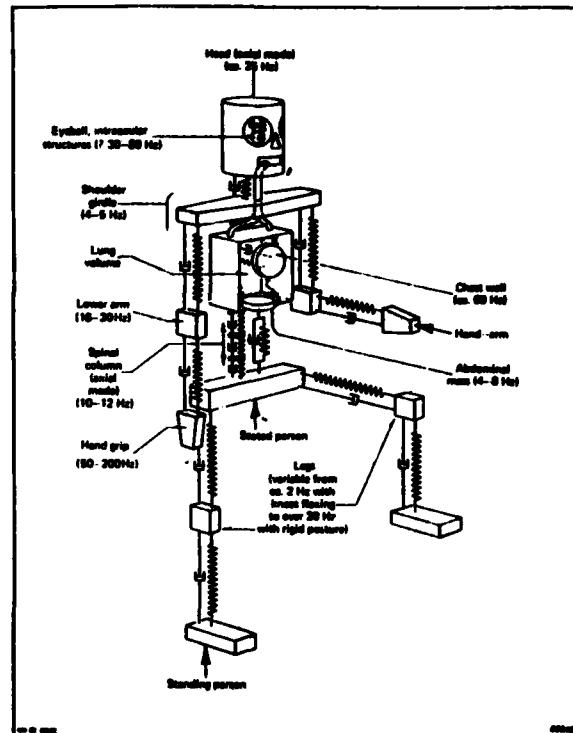


Fig. 1. Simplified mechanical system representing the human body standing on a vertically vibrating platform.

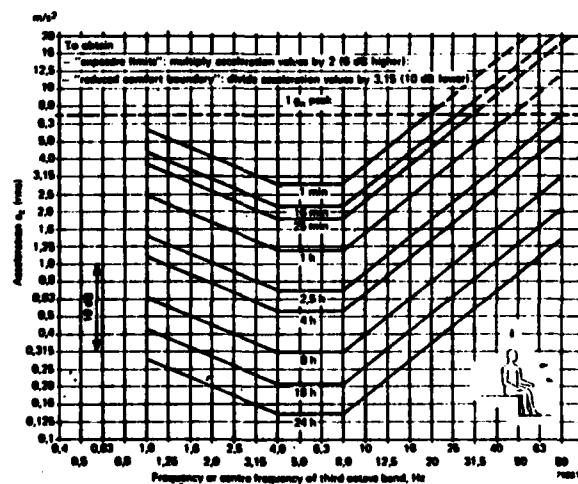


Fig. 2. Vertical vibration exposure criteria curves defining equal fatigue-decreased proficiency boundaries.

Rasmussen, there are three critical parameters: duration of pulse-rise time, maximum peak-to-peak displacement of the pulse, and the frequency of the pulse. Such limit curves are only guidelines, but they are believed to be appropriate for healthy persons who are already adjusted to reasonable job stresses. (The author visited a nearby London construction

site as this article was being written and observed that extremely unpleasant levels seemed to be reached there. Occasionally, two pile drivers were operating simultaneously, and if the main pulses were nearly superimposed, the subjective discomfort and aversion were pronounced. There was also a cognitive element; when both pile drivers were operating in a not-quite-regular rhythm, nearby observers could feel the frequencies converge on a simultaneous "hit"; the prediction of the hit, and the "hunching" in preparation for it, take considerable mental processing.)

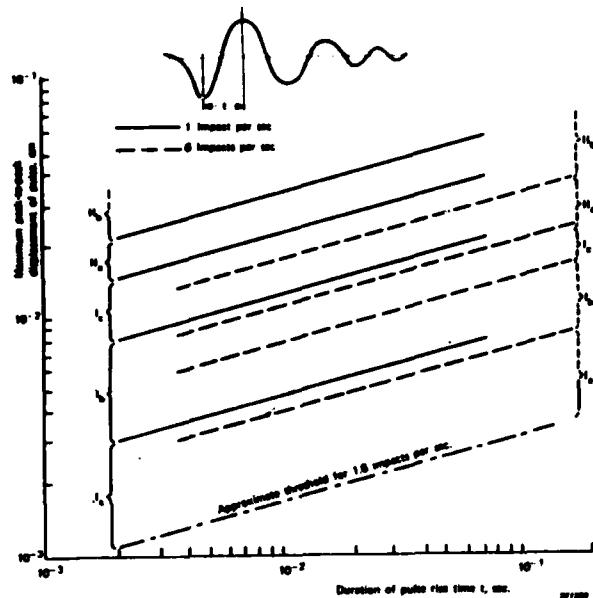


Fig. 3. Tolerance of human subjects in the standing or supine position to repetitive vertical impact pulses representative of impacts from pile drivers, heavy tools, heavy traffic etc. Subjective reaction is plotted as a function of the maximum displacement of the initial pulse and its rise time.

Tools such as chain saws, motorized grinders, and chipping hammers can cause physiological damage to the human operator when used for long periods. After only a few minutes of chain-saw work, partial numbness may be experienced in the hands; the effect is probably the cause of many chain-saw mishaps; as the grip is involuntarily loosened there is insufficient "grip feedback" from the hands. In extreme cases of long exposure to vibrating power tools, "dead hand" or Raynaud's disease, with permanent disability, may result. Rasmussen and others have plotted guideline-risk curves for hand-held tools; an example is shown in Figure 4. Permissible exposure limits can also be plotted as a function of time; human percentiles of "time exposed before very impaired performance" have been published, and it is likely that before long some of the

guideline numbers will appear in damage claims and lawsuits. Manufacturers are concerned and are testing tools and handles that damp out much of the vibration but still permit firm control and good feedback. "Remoting" of the man from the tool, along with partial robotization, has already been accomplished in some industrial settings.

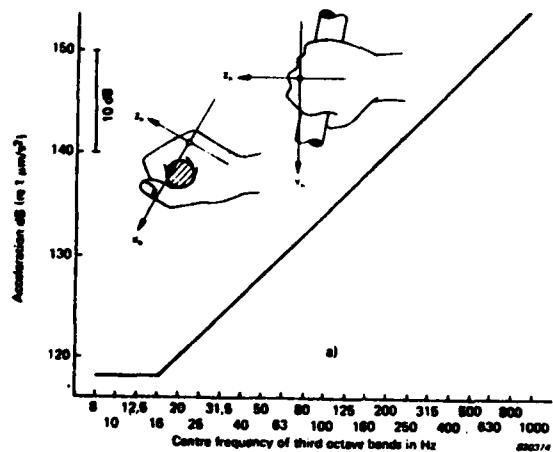


Fig. 4. Exposure guidelines for vibration transmitted to the hand.

There are many ways to measure vibration signals; all have advantages and drawbacks, and apparently no agreement has yet been reached among countries and laboratories on a norm. Among the possibilities are positive peak, negative peak, maximum peak, average rectified peak, and dose (acceleration integrated over time). Brüel and Kjaer recommends the use of rms acceleration ( $m/s^2$ ) over a 1/3 octave frequency band, or over a 1-octave band for hand-held tools. Another measurement technique cites the level of vibration in db units; in this system, a vibration level is 20 times the  $\log_{10}$  of the ratio of a weighted acceleration to a reference acceleration of  $1\mu m/s^2$ . Rasmussen's weighting scheme uses different time constants for the several bands:

- <1 s for the 0.1 to 1 Hz range
- <10 ms for the 1 to 80 Hz range (whole body)
- <1 ms for the 10 to 1,000 Hz range (hand/arm).

Decisions about which axes to sense will depend on the exposure situation. An overall rms-weighted acceleration can also be calculated; in research and evaluation studies, all the time constants should be quoted, as they can affect the computed outputs.

A practical device for assembling vibrational data into a functional display would then take as inputs such parameters as the accelerations and frequencies on the X, Y, and Z axes, the rise and decay time constants for each frequency band, and the signal-averaging constants. The calculated outputs would represent vibrational levels, perhaps in some

practical unit such as db. The outputs could also be presented in a qualitative display. Rasmussen's front-panel design (Figure 5) has separate display units for motion sickness, whole-body, and hand-arm readouts; simple switches are provided for such things as display mode and seat accelerometer specifications. There are many other features that could be added; the present design and the analyses underlying it will probably undergo extensive field trials in Denmark and other countries. The small package (front panel about 10x7 inches) could easily be put into any vehicle undergoing test and development. For detailed analysis of the vibrating situation itself, the instrument could be supplemented with additional multiaxial tape recorders, special transducers, and so forth.

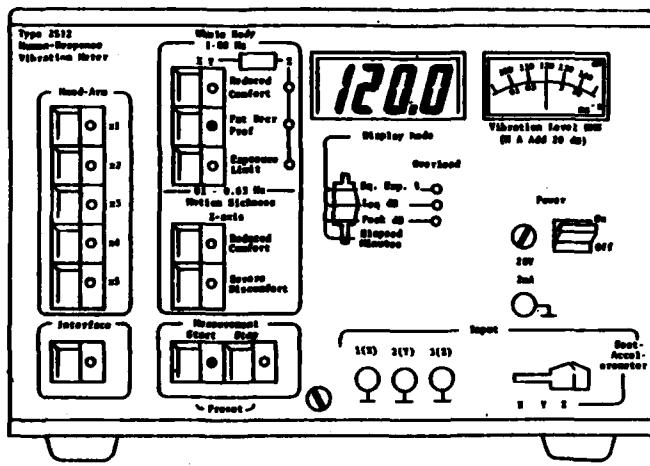


Fig. 5

The transmitted accelerations of hand-held vibrating implements are not the only parameters of interest; energy transmitted between hand and tool may be a biologically significant measure, and such energy depends on the mean and variance of grip pressure. To measure the energy coupling of hand and tool, Brüel and Kjaer has designed a special handle; it is made of light metal and has built-in accelerometers. Tests of the transfer function from tool handle to hand adaptor show a close tracking of vibrational levels between hand and handle, except for a slight overestimation of energy fed to the hand at around 1,000 Hz. Thus it would appear to be a conservative practice to take the handle-energy-level measurements as sufficient indicators of risky vibration. The adaptor handle, when fitted to a standard chipping hammer, measured some vibrations in the 150-db range; the trial showed good tracking between hand-adaptor levels and those recorded from a stud-mounted accelerometer on the tool itself.

Transducers and setup standards for hand and whole-body vibration are already available for most practical situations. With the development and refinement of compact devices

like the Brüel and Kjaer meter, vibrational displays should become routine for many vehicles and work stations. The time may well be ripe for convening an international meeting on vibration to facilitate the sharing of techniques and ideas, to stimulate research and acceptance of standards, and to help ensure that there is no unnecessary overlap of projects.

*N.A. Bond, Jr.*

ONR London

## VISIBILITY PROBLEMS IN JET AIRCRAFT

It is a bright European morning, with clear blue skies. Commercial jetliner A is proceeding on course at 33,000 feet. About 36 miles away is commercial jetliner B, which has a contrail some seven miles long behind it. Unknown to the pilots of either plane, the two airplanes have just been cleared to a collision course at the same altitude and are now closing at 800 miles an hour. After 2 minutes and 50 seconds on this course, the wing of jetliner A slices through the cockpit and cabin of jetliner B. All 176 persons aboard the two aircraft perish (amazingly, a couple of people, including a baby, survived the crash but died shortly thereafter).

The foregoing scenario, or something very much like it, occurred over Yugoslavia in 1976. As one of the worst mid-air crashes on record, it has been investigated by many boards and courts; damage suits and hearings are still going on. There is no dispute that poor air traffic controlling was one of the main causes of the accident. But the follow-on analyses showed that many other precipitating factors could be discerned. For example, there was a heavy workload on the air traffic controllers and bitter personal animosities among them. Another item was the usually innocuous request from the control center to aircraft A to put its altitude transponder on STANDBY; when it is set in that mode, there is temporarily no way for the controller to know the altitude of the aircraft.

At the cognitive level, there were also a number of possibly contributing factors. The pilot of aircraft B had been proceeding across Europe at 33,000 feet for some time, so he could reasonably expect that a protective block of air around him at that altitude would be maintained. On the other hand, all aircraft in the area must have known that the local area was extremely congested; aircraft A, for example, was not able to contact the upper sector controller for 2 minutes, because that controller was continually talking to other aircraft. Language may have been another contributing factor: despite the multi-lingualism required of all controllers, there are often problems with intelligibility; this is especially so in eastern Europe. In fact, a crucial part of the accident

Investigation will never be definitely resolved, because of intelligibility of key words spoken by the controllers.

Granted that the planes were improperly controlled and cleared, from the standpoint of visibility, how could the crew of aircraft A have not seen aircraft B? B had a long contrail and was flying into the sun, while the sun was behind aircraft A. A general answer to the question is that aircraft are often surprisingly hard to see; a specific answer in this case is that aircraft B, and its long contrail, may have been almost totally obscured by the windshield posts in aircraft A! This possibility has been examined by Stanley Roscoe (New Mexico State Univ., US), who recently presented some of his findings at the 2nd European Conference on Human Decision Making and Manual Control, Bonn, Germany, June 2-4, 1982.

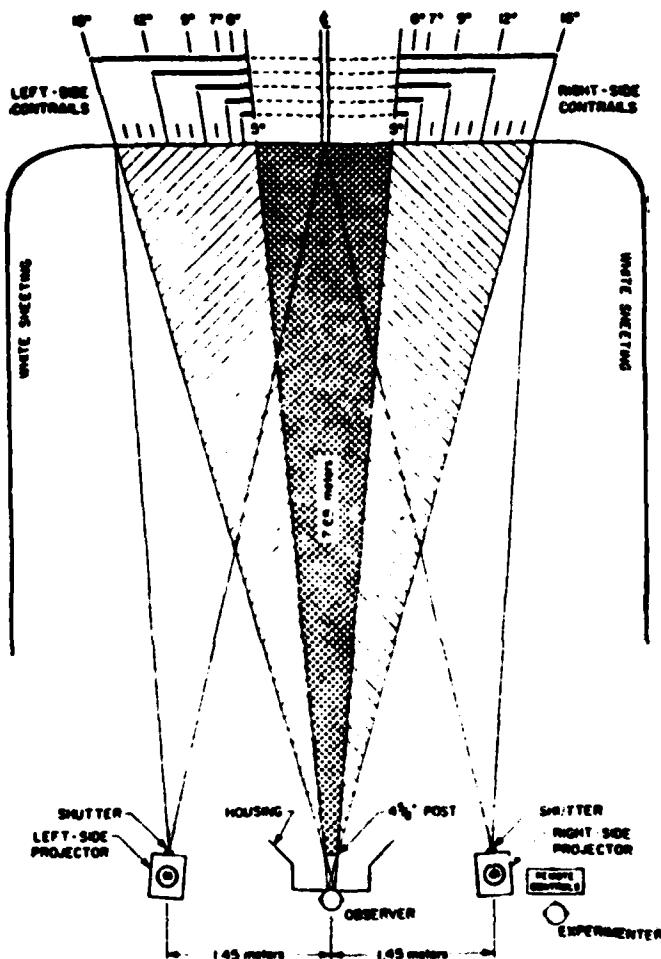
Roscoe's analysis began with the layout of the captain's station in aircraft A. The geometry of aircraft B's approaching track indeed showed that, for the last 3 minutes of flight, much of aircraft B's contrail and body would have been obscured by the posts, which were over 4 inches wide in some places. In a series of laboratory trials with pilots of various ages, Roscoe also found that a pilot tends to have a "relaxed" eye focus at about arm's length (mean of 24 inches or less), and when a post is present, there is a tendency to focus on the post (mean of about 12 inches).

To simulate a contrail-detection task, Roscoe put pilot-observers in a laboratory setup and presented contrails of various lengths for 300 ms, with a white ganzfeld screen as background. Posts like those in aircraft A were built in to obscure part of the image as would happen in the real cockpit. The subject was asked to report the lateral location (right, left) and elevation (high, middle, or low) of each contrail target. A schematic view of the experimental setup is shown in the figure.

With young pilot subjects, post width had a drastic effect on the detection of targets that were only 6 to 9 degrees to the left or right of the post. At 6 degrees, for instance, the wide-post (4.6 in.) condition resulted in a detection probability of about 0.10. Not until the contrail extended out to 9 degrees and beyond did the estimated detection likelihood rise above 50 percent. The 2½-in. post was much better, yielding detection probabilities estimated to be in the 0.80 range.

So it was established that when the pilot was looking straight ahead, contrail detection was difficult. Typically, though, pilots look past one side of a post and then past the other side. When Roscoe's subjects were allowed to turn their heads, their performances improved significantly, although length of contrail remained a powerful factor in detection performance.

As the relaxed focal range increases with age, it might be that older pilots would be less susceptible to "empty field myopia," and so would be better at seeing contrails. In a small



The schematic diagram of Roscoe's laboratory setup, including indications of the visible portions of simulated contrails of various angular lengths as they appeared to the right or left of a simulated window post 4.62 inches wide and 12 inches in front of an observer's eyes.

test of this conjecture, Roscoe gave three older certified pilots the same task, and their performance indeed looked a little better than that of the younger men.

Roscoe's analysis of the cockpit visual situation, along with his laboratory simulations of contrails and obscuration, yields a rather convincing interpretation of visual aspects of the accident. In all likelihood, the target simply was not conspicuous enough to override such features as the total or partial obscuration by the window posts and the empty-field myopia of the pilots involved. To study further the cockpit stimulus environment for the last 3 minutes before the crash, Roscoe and his associates made an animated cartoon presentation of aircraft B as it must have looked from the left-hand seat of aircraft A. It is a dramatic film. The seconds remaining tick off in one corner. For much of the 3 minutes, the "body" of aircraft B is either invisible to a fixed-head look, or is just barely past the post; and the contrail is similarly obscured,

though less drastically so. Although it was not the main purpose of the film, the viewer receives a startling view of what an approaching airplane looks like, at high closing speed. The approaching aircraft "blooms" so suddenly, that even though it is very likely that both crews perceived the imminent collision in the last few closing seconds, no effective response was possible.

Several analysts have concentrated on the Yugoslavian mid-air tragedy and have followed not only the technical and legal hearings but also the fate of the air traffic controllers involved. Ronald Hurst (Reading, UK) recently devoted an entire book (*Cleared To Collide*) to the case; his report suggests that one controller, who was imprisoned for his mistakes, may have been something of a scapegoat; the Zagreb air traffic control system clearly was inadequate for the heavy international traffic using it every day. Hurst showed that the designation of a scapegoat, and his subsequent incarceration, may have served to divert attention from other possible causers: the air control electronics people, the planners, the aircraft manufacturers, and the certification agencies in various countries.

The likelihood of tragedies like the accident discussed here happening can be lessened by new proximity devices and by tightened surveillance and procedures. In fact, the official response of the air traffic control authorities and laboratories has included such proposals. It is still true, however, that only a small fraction of commercial and military flights are controlled or protected in a special regimen. And the new generation of jetliner cockpits just now entering service still has obscuring posts in the cockpit.

For the aircraft designer, eliminating the visual limitations arising from present-day cockpit window posts will pose a major problem. As the object to be detected gets closer to the edge of a post, the empty-field myopia phenomenon becomes more serious. Perhaps one or two jetliner generations from now, posts will be eliminated and there will be several levels of electronic warning arrangements.

The case shows, as most such tragedies do, how manifold the causes really are. Slight changes in any one of at least half a dozen messages and perceptions of events could have prevented the collision. A challenging question: while it would be theoretically possible to sample and test continually nearly every active element in an air-traffic-control environment, at what point would the system be spending so much of its resources in monitoring and testing itself that its actual ability to do its job was reduced rather than enhanced?

*N.A. Bond, Jr.*

ONR London

## CHEMISTRY

### EUROPEAN CHEMICAL CONFERENCE ON MOLTEN SALTS

The European Chemical (EUCHEM) conferences on molten salts are held biannually in years alternating with the Gordon conferences on molten salts and metals, which take place in odd-numbered years in New Hampshire. The format of the European conferences closely resembles that of their American counterpart, which is not surprising as they were started in 1966 by the Norwegian group at Trondheim, many of whose members had attended the Gordon conferences. Since its inception, the conference has been held in nearly every European country that has an active molten-salt program. The 1982 meeting was held from 24 to 28 May at La Gaillarde, France, about 30 miles west of Cannes. It was chaired by Dr. M. Gaune-Escard, who heads a program at the University of Provence in Marseille.

The scientific program was divided into eight groups: transport, electrochemistry, structure, reactions, computer simulation, metal-molten salt solutions, thermodynamics, and applications. Each group contained one or two conference lectures (1 hour each), communications (20 minutes), and posters. The sheer number of papers, nearly 90, precludes a thorough discussion. Mention of specific papers reflects the bias of the author.

The session on transport included a conference lecture by J. Franz (Indiana Univ., US) on the effect of electronic structure on electrical conduction in alloys. Franz interpreted the rather odd maxima and minima in the electronic conductivity-composition curve of metals that differ greatly in electronegativity, e.g., Cs-Sb, in terms of metal-nonmetal transitions resulting from strong scattering of electrons by the atomic cores. Transport in molten salts and its relation to structure (molecular, simple ionic, or complex ions) was discussed by A.R. Ubbelohde (Imperial College, London, UK). Other contributions in the area dealt with what have become somewhat standard topics: the slight electronic conductivity in ionic melts (J.J. Egan, Brookhaven National Lab.), the Chemla effect (cases in which the conductivity of the larger ion exceeds that of the smaller in some binary melts by a Japanese group from the Tokyo Institute of Technology), and results of a search for more low-melting molten salts (by a group from the US Air Force Academy).

Electrochemistry was one of the more active areas at the conference, including 12 contributions. In this field, the thought of applications never seems to be very far from even basic studies. During the past several years and also at this conference, topics

included molten salt batteries, fuel cells, and electrodeposition of metals (particularly as related to aluminum production). In addition, electrochemists are always looking for new techniques to help them interpret their measurements. One of these currently under active development is spectroelectrochemistry. It was discussed in a conference lecture by G. Mamantov (Univ. of Tennessee, US), who has been responsible for much of the progress. The technique consists of observing spectral changes (UV-visible transmission, electron spin resonance, and Raman resonance) occurring simultaneously with changes at the electrodes. Extensive use is made of transparent electrodes, such as fine wire grids. The method holds great promise for improving the connection between chemistry inferred from changes in electrochemical parameters and spectroscopy, which is tied more closely to chemical species. Among papers treating deposition were a presentation by D. Inman (Imperial College, London, UK) on the successful deposition of chromium by the reduction of Cr<sup>+2</sup> from LiCl-KCl melts; a study of K<sub>2</sub>TiF<sub>6</sub> reduction in molten fluoride, by M.J. Barbier (CNRS, Saint-Martin D'heres, France); and a discussion of the first electrodeposition of a refractory carbide (TaC, Ta<sub>2</sub>C) by simultaneous reduction of Ta<sup>+3</sup> and CO<sub>3</sub><sup>2-</sup> from molten fluorides, by K.H. Stern (Naval Research Lab., Washington DC). The deposition of aluminum from chloride melts, a process that should lead to improved efficiencies over current processes, was discussed by J. Thonstad (Norwegian Inst. of Technology, Trondheim).

The structure of molten salts, i.e., the arrangement of simple and complex ions in the liquid, is a subject of perennial interest to both theorists and experimentalists. Thirteen papers, introduced by a conference lecture by J.E. Enderby (Univ. of Bristol, UK), on diffraction experiments of isotopic substituted salts and the information derivable from the results, were presented in the section on structure. Several of the computer-simulation presentations were also concerned with structure. The papers dealing with structure were somewhat more experimental than usual, including also some work on transport. Techniques described included Raman spectroscopy of SnCl<sub>2</sub>-AlCl<sub>3</sub> melts (B. Tremillon, Univ. Pierre et Marie Curie, Paris) and of salt vapors (G.N. Papatheodorou, Univ. of Patras, Greece), EXAFS (B.R. Sundheim, New York Univ., NY), hyper-sonic relaxation by Brillouin spectroscopy (L.M. Torrell, Chalmers Univ. of Technology, Göteborg, Sweden), and vibrational and reorientational relaxation in nitrates (R. Martin, Univ. of Provence, Marseille).

In contrast to previous meetings, at which computer studies were more heavily weighted toward structure, there seemed to be more emphasis on molecular dynamics and transport. J.H.R. Clarke (Univ. of Manchester, UK)

discussed the structure of KCl near an electrode. Transport papers included computer simulation studies of ion migration in ionic liquids and glasses (C.A. Argell, Purdue Univ., West Lafayette, Indiana), molecular dynamics in LiCl-KCl (F. Lantelme, Univ. Pierre et Marie Curie, Paris), and transference numbers in a one-component salt (B.R. Sundheim, New York Univ., NY). The current efforts in this field seem to be centered on relating transport properties to structure.

As usual, thermodynamics was an active topic, with 15 contributions. In a conference lecture, B. Cleaver (Univ. of Southampton, UK) discussed the extension of his organization's active high-pressure program to the effect of pressure on miscibility. Three papers (H.A. Oye, Trondheim; M. Blander, Argonne N.L.; U. Gesenhues, Inst. for Chem. Techn., Darmstadt, FRG) were concerned with chloraluminate melts. A talk on the application of state equations to halide melts of divalent and trivalent metals was given by I.G. Murgulescu (Polytechnical Inst. of Bucharest, Romania), one of the major figures in molten salt chemistry since the 1950s, who was exempted from the requirement that all talks be in English. He read his paper in French.

Metal-molten salt solutions have been of interest ever since the 1950s when a group at Oak Ridge National Laboratory determined the phase relationships of alkali metals in their molten salts, e.g., K-KCl. In general, the addition of the salt drastically lowers the conductivity and also leads to magnetic transitions, topics that were discussed by J. Thonstad (Univ. of Trondheim, Norway) and W.W. Warren (Bell Labs., US), respectively.

Several papers dealt with molten salts as reaction media and as reactants. G. Pedro Smith (Oak Ridge NL, US) described the results of a large program in which SbCl<sub>3</sub>-rich melts serve as a reaction media for the transformation of aromatic hydrocarbons. Reaction mechanisms involve radical cations generated by reduction of Sb<sup>+3</sup> and also carbonium ions. The interest in industrial SO<sub>2</sub>/O<sub>2</sub> catalysts spawned papers on V<sub>2</sub>O<sub>5</sub> in sulfates by D.H. Kerridge (Univ. of Southampton, UK) and (less directly) N.J. Bjerrum (Tech. Univ. of Denmark, Lyngby). Reactions between oxides in molten salts, a topic of interest in molten salt corrosion, were discussed by B. Durand (Univ. Claude Bernard, Villeurbanne, France). For example, NiO and Al<sub>2</sub>O<sub>3</sub> react in molten salts to form NiAl<sub>2</sub>O<sub>4</sub> through the operation of various equilibria. In a similar vein, complex formation of Cu (I) and Cu(II) in KCl-AlCl<sub>3</sub> melts was examined both potentiometrically and spectroscopically by J.H. Von Barner, (Technical Univ. of Denmark, Lyngby).

There were relatively few papers (7) directly labeled "Application." Among them was an enthusiastic presentation by K. Furukawa on the molten salt reactor program of the Japanese Atomic Energy Research Institute, in which molten fluorides are used for breeding. The

corresponding French program was discussed by M. Brigaudeau (Commissariat à l'Energy Atomique). Other papers dealt with aluminum production (U. Gesenhues, Inst. of Chem. Techn., Darmstadt, FRG, and W.E. Haupin, Alcoa, US), and metalliding by niobium (P. Taxil, Lab. de Chimie, Toulouse).

The next conference will be in Denmark in 1984.

K.H. Stern

NRL Washington, DC

## ENVIRONMENTAL SCIENCES

### COASTAL PROBLEMS AND THE MEDITERRANEAN SEA

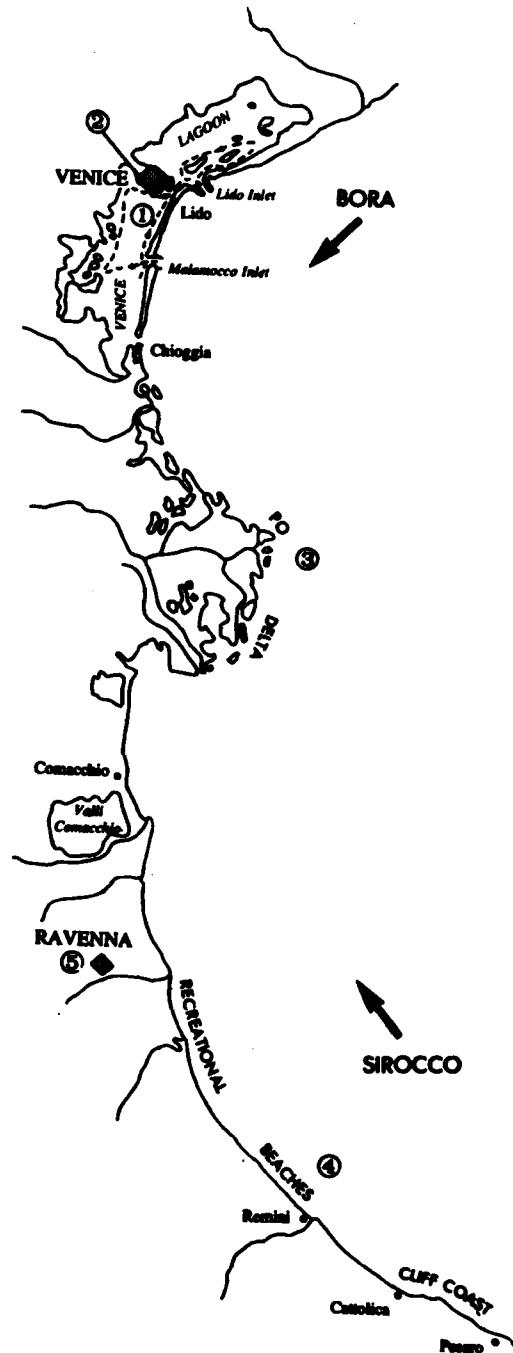
During the last 5 years the Commission on the Coastal Environment of the International Geographical Union has held nine symposia. The most recent was convened on 10 May 1982 in Venice, Italy, to consider "Coastal Problems in the Mediterranean Sea." The eight previous symposia, held in Canada, France, Japan, Nigeria, Sweden, and the United States, dealt with a variety of themes.

The Mediterranean Sea symposium, organized by Prof. Paolo Fabbri and his colleagues of the University of Bologna, attracted some 35 participants. Twenty-one were from 10 countries other than Italy. Mediterranean countries represented included France, Italy, Spain, Tunisia, and Turkey. In addition, coastal scientists from Belgium, West Germany, The Netherlands, Norway, and the US were in attendance.

Because the organizers considered that the best way to familiarize outsiders with local coastal problems was discussion in the field, 3 of the 5 days were field-oriented. On the first day (see map), the group was immersed in the problems of the Venice Lagoon via an all-day, 70-km boat trip around the lagoon. This orientation was followed on the second day by a paper session in the Italian Consiglio Nazionale delle Ricerche (CNR) building in Venice. The third day was spent examining the Po River Delta and the Adriatic coast south to Ravenna, and the fourth day involved a field survey of the long recreational coastal zone south of Ravenna. On the last day a number of papers (mostly about Mediterranean coasts outside Italy) were presented.

#### The Venice Lagoon

The boat trip in the lagoon began at the Lido (see map), and progressed counterclockwise around the lagoon south of Venice during the morning and counterclockwise around the lagoon north of Venice during the afternoon. On the trip, a number of researchers from CNR and other Italian organizations presented a running account of the nature and



problems of the lagoon. Sixteen specific locations, many with short stops, had been selected for detailed discussion. Included were statements about the development of the historical center of Venice, the first and second industrial zones, tidal flats of what is called the dead zone of the lagoon, land fill in the lagoon, the nature of the living lagoon, Malamocco and Lido inlets, the lagoon's canals, and some of

the famous islands including Torcello, Durano, and Murano.

The lagoon is 52 km long, varies in width from about 8 to 14 km, and has an area of 586 km<sup>2</sup>. However, of this total only 276 km<sup>2</sup> (47 percent) are still connected to the sea via the three tidal inlets. The rest of the lagoon (referred to as dead) has been separated from the sea by dikes. Although the average depth of the lagoon is only about 1 m, the maximum depth, at the Malamocco inlet, is 45 m. This is the deepest spot in all of the north Adriatic Sea. Of the 800 km of canals in the lagoon about one-fifth are over 4 m deep. The canals leading to the industrial and commercial sections of the lagoon are about 14 m deep, a depth maintained by dredging.

Reclamation within the lagoon has been more or less continuous for centuries. Recently, however, several laws were passed that limit lagoonal modification. The concern for the lagoon resulted in the shelving of plans to establish a third industrial zone. Although a number of problems exist throughout the lagoon (erosion, sedimentation, pollution, and the like) most attention has been focused on Venice itself. The "Maladies of Venice," as the problems have been called, are numerous and solutions are difficult. Among them are: (1) subsidence, both natural (compaction and tectonic lowering) and man induced (groundwater withdrawal); (2) rising sea level because of eustacy; (3) flooding caused by high tides and by strong winds such as the bora and sirocco (see map); (4) erosion caused by human alteration of lagoonal dynamics through the construction of jetties and dams and because of subsidence; and (5) pollution, both water and air, among others.

Four of the eight papers presented during the second day of the symposium provided details on many of the above problems. Paolo A. Pirazzoli (Laboratoire de Geomorphologie de l'Ecole Pratique de Hautes Etudes, Montrouge, France) lectured on "Flooding (acqua alta) in Venice (Italy): A Worsening Phenomenon." He noted that in the city of Venice, flooding frequency has recently been on the increase. His research has shown that during the past 110 years (for all of which tide records are available), the acqua alta level has increased by 40 cm, 27 cm because of local rise in mean sea level and 13 cm because of the tidal changes caused by man. The dredging of man-made channels, tidal flat reclamation, and the creation of fish ponds have all contributed to the changes.

Pirazzoli discussed a project that is being proposed for further dividing the lagoon by constructing a dike south of Venice. It is considered that such a dike would increase the danger of flooding in Venice during the bora, i.e., northeast winter winds that are often quite strong. Even if such a dike is not constructed, the next few years are likely to witness more than average flooding in Venice. Pirazzoli's research has shown that the intensity

of flooding in Venice is related to the 18.61-year lunar declination cycle and that the high-water part of that cycle will occur between 1982 and 1987.

Silvia Cavazzoni (Istituto lo Studio della Dinamica delle Grandi Masse, CNR, Venice) read a paper entitled "Recent Erosive Processes in the Venetian Lagoon." Her research was done by comparing bathymetric and morphologic data for the years 1901, 1934, and 1971. Because circulation in the central part of the lagoon is largely controlled by a wide, straight, and deep canal, there has been siltation and shortening of the side channels as well as the disappearance of the submerged channel levees. In contrast, erosion has resulted in an increase in width and length of the channels in the northern and southern basins of the lagoon. The result has been to decrease bottom relief in the central part of the lagoon and increase it to the north and south.

Laura Carbognin of the same institute spoke on "The Lagoon of Venice and Subsidence." As a member of the international commission on land subsidence, she has concentrated much of her research effort on subsidence as induced by groundwater withdrawal. After a review of the physical nature of the aquifer-aquitard structures and the history of groundwater rise, she presented data on the correlation of subsidence and groundwater withdrawal. The piezometric levels dropped 20 m in Marghera (the industrial zone) and 10 m in Venice in 1969 and land sank 14 cm in Marghera and 10 cm in Venice. Although pumping is now restricted and subsidence due to water withdrawal has ceased (indeed a slight rebound has been measured), the subsidence caused by former withdrawal has aggravated flooding in Venice.

Paolo Rosa Salva, a Venetian urban architect, treated lagoonal ecology. He noted that because of human modifications the central part of the lagoon is now more marine than it was in the past and that only the northern part is more or less typically lagoonal. He pointed out that the conflict between the development of port traffic and the protection of the lagoon environment led to a stalemate that has lasted for more than a decade. Rosa Salva stated that, given the present social and economic climate of the Venetian area, it is a stalemate that needs to be resolved soon.

#### The Po Delta

On the third day the group went by bus south of Venice to Ravenna, visiting the Po River delta on the way. This part of the trip was led by Marcello Zunica (Univ. of Padua). Zunica is probably the foremost authority on the Po delta, a region in which he has studied both physical and human aspects.

The Po River drains more than 70,000 km<sup>2</sup> (nearly  $\frac{1}{4}$  of Italy). The water and sediments of the delta originate in both the Apennines and the Alps. The delta, like most deltas, has had a dynamic geomorphic history. During the

Roman era the shoreline between Chioggia and Ravenna was a series of long coastal ridges, the remnants of which range from 3 to 27 km inland from the present shoreline. Until about 400 years ago the Po migrated relatively freely up and down the coast. Some 10 former deltaic lobes have been identified. The growth rate of the early deltas averaged about 450 m per century, which contrasts greatly with the average of 7 km per century for the present deltaic lobe.

The nature of the Po delta, unlike that for most of the world's deltas, has been documented since at least the time of Pliny the Elder. As the Po River was an important route between the Adriatic Sea and the Alps, its coastal extension was well known. Pliny the Elder noted that the Po River had seven principal outlets with its most northerly and most southerly channels being about 200 km apart. The shoreline itself was backed by lagoons that even in those days were connected by "fossae" or artificial channels. Thus littoral transport was relatively easy. The economic pursuits in the deltaic environments were varied and numerous. Pig breeding, brick manufacturing, and charcoal production (there was even a town named Carbonaria) were present although it is thought that fishing and solar salt production were dominant. Salt ponds, for example, were responsible for the development of the city of Comacchio (see map) in the eighth century.

The present Po delta is artificial in that its growth has been affected by a number of human activities including deforestation in the drainage basins, damming of the Po's tributaries, increased agriculture, and increased construction of levees and dikes. Although man had been exerting some control over the Po for centuries, it was not until 1604 that the diversion that set the stage for the growth of the present Po delta was opened. It was constructed in order to divert river flow from the Venice Lagoon and save it from silting up. The Venetian superintendent at the time (September 16, 1604) is quoted by Zunica as saying, "Today at 7 o'clock in the evening with the grace of the Lord, water has been let into the new cut channel..."

Since the diversion over 500 km<sup>2</sup> of new territory have been added along a stretch of the Adriatic coast about 30 km long. Most of the new territory is being used. The dominant activity is agriculture, which increased many-fold between World Wars I and II. Agricultural activities are varied and include growing sugar beets, cereal grains (such as wheat, corn, and rice), animal fodder, hemp, and poplar trees (for paper pulp) among others. Because of such crops a number of small industries (such as sugar refining, rope production, and paper manufacturing) have sprung up in the delta.

The second most important activity in the delta is pond-fish production. Fishing has been a major occupation since the present delta began to form and includes mullet, sea bass, and eels. In order to cultivate fish, extensive

diking is necessary. Diking (whether for agriculture, fish breeding, or flood protection) has helped bring about subsidence within the delta which, in turn, has led to changes in salinity. It has also led to the promotion of algal growth and to drainage difficulties. Such changes affect both agriculture and fish breeding.

In some parts of the delta most of the subsidence was caused by the overpumping of subdeltaic water during the extraction of methane. Because this industry had such an adverse effect on the deltaic surface, methane production was prohibited during the late 1960s. During the previous 30 years, some areas of the delta subsided by as much as 5 m and great expense was involved in the almost continuous levee construction that such subsidence necessitated.

One of the most recent changes in the delta has been a reduction in the rate of growth and even the initiation of erosion along some parts of the delta front. These phenomena have occurred mainly because of the loss of sediment resulting from an increase in river bed mining.

At the present time, there are a number of groups that have conflicting interests in the delta. The major friction is between the farmers who would like to reduce further the amount of water-dominated area and the fishermen who would like to increase it. Additional conflicts are beginning to appear because of the increasing interest in developing tourism and initiating new industries.

#### The Recreational Beaches

Immediately south of the Po delta is a marshy plain that is bordered by wooded dunes. The trees were planted at the turn of the century to protect the agricultural areas behind the dunes from sea winds and salt spray. In 1960 a good road was constructed to the coast and the area was opened to tourists. Between this location, a few kilometers north of Comacchio, and Cattolica, a distance of over 100 km, there is a vast array of artificial structures designed to protect the shoreline and the numerous hotels developed for tourists. The structures include seawalls, offshore breakwaters, groins, and jetties, most of which are made of rock. There are very few tetrapods along this coast. Some structures were made as much as 75 years ago, but most of the construction occurred in the last 20 years. As is often the case where groins and offshore breakwaters have been constructed, the rate of erosion has increased in downdrift locations. Trapping of sand has occurred and tombolos (land-tied islands—in this case, land-tied breakwaters) have formed in some sections.

#### Ravenna and the Coastal Zone

Ravenna, which served as base during the last 3 days of the conference, is one of the ancient cities of Italy and once was the base for the Roman fleet in the eastern Mediterranean.

At that time it was a coastal city but, because of accretion, it is now some 8 km inland. Nonetheless; it is still the second most important harbor on the Adriatic and supports large petrochemical, fertilizer, and synthetic-rubber industries. The port entrance is protected by the two longest jetties (over 2.5 km long) on the Adriatic Sea. They were built out to a water depth of 8.5 m to avoid filling of the entrance by longshore drift.

P.Catto (CNR) presented a paper on the second day that dealt with the Ravenna coast. He asserted that many of the problems in the Ravenna area are caused by subsidence, which amounted to more than 1 m between 1949 and 1977. He stated that in addition to having caused "irreversible damage to historical monuments" it also has jeopardized tourism because of the imbalance it has caused in the coastal regime. On the last day, M.Ferraresi (Isdroser SpA) discussed "A New Project for Littoral Processes Control and Coastal Management in Emilia-Romagna." The paper was timely because during the two previous days the group had examined the coastline in some detail and had had an opportunity to see some of the problems firsthand. Beach erosion, subsidence, and flooding (as much as two-thirds of the shoreline are susceptible to flooding) are the dominant problems. The project, which is now being initiated, has as its principal purpose the monitoring of all the physical factors related to beach erosion, coastal flooding, and subsidence. It will include a study of the impact that artificial structures along the coast and within the catchment basin are having on the shoreline. In addition, part of the research will be devoted to determining to what extent artificial nourishment of beaches should be employed.

#### Other Mediterranean Shores

In addition to the papers devoted to the Adriatic seacoast, the symposium also had presentations about other Mediterranean shorelines. Three of those papers, each with a different approach and emphasis, are discussed briefly here.

O. Erol of Turkey showed that his country's coastline is very complex. Most of it, such as those parts on the Black Sea and Mediterranean, is made up of highlands that parallel the major mountain chains. The coasts have been little altered by contemporary processes. In contrast, the coastline along the Aegean Sea crosses structural trends and is characterized by sizable deltaic plains that have developed at the oceanic ends of structural troughs. One of the impressive features of Erol's lecture was the use of a series of his geomorphic diagrams of Turkey's coast.

M. Marqués and R. Juliá of Spain presented information about the small (100 km<sup>2</sup>) deltaic plain at Alt Emporeia in northern Catalonia. It is being downwarped, and this, in combination with regular deltaic processes, has resulted in a set of peculiar problems including (1) salinization of ground water aquifers

because of a poorly developed fluviomarine wedge, (2) unstable building foundations, (3) frequent channel changes in the two rivers that form the delta, (4) occasional extensive flooding of the region's marshes, and (5) an alteration between accretion and erosion along the shoreline. Types of human modification they noted ranged from drainage basin regulation and dune fixation to the development of Venice-like tourist settlements.

R. Paskoff of Tunisia, who has spent many field sessions investigating the Tunisia coastline, concentrated on the changes occurring along its sandy beaches. Beaches occupy 485 km of Tunisia's shoreline. He found that along 360 km (about 75%) of the coast the beaches are stable, along 115 km (most of the rest) they are retreating, and along only 10 km are they advancing. In some places (as in the Gulf of Tunis) erosion is severe. Reasons for erosion are numerous and include human activities as well as natural processes. He said that the development of tourism during the past 20 years has aggravated coastal erosion in some places. The rates of erosion along some Tunisian shores are relatively easy to calculate by observing the numerous ruins (including military blockhouses and burial tombs) that are being destroyed by wave action.

#### Conclusions

Participants in this 5-day conference could hardly leave without feeling somewhat uneasy about what is happening along the shorelines of the world as well as in the Mediterranean and the Adriatic. It gave evidence that the pressures being exerted by man on coastlines are both intensive and extensive and that in most cases the pressures are proceeding well ahead of relevant research. Therefore, it is not surprising to find that many coastal modifications are necessitated by disasters that were caused or at least aggravated by uninformed approaches to coastal utilization. At the same time, however, it was encouraging to note that some meaningful research projects are under way in many parts of the world and that there appears to be an increasing interest in treating the coastline as an endangered element of the environment.

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## COMMUNICATION SCIENCES

### INTERNATIONAL CONFERENCE ON ACOUSTICS, SPEECH, AND SIGNAL PROCESSING

The International Conference on Acoustics, Speech, and Signal Processing (ICASSP 82) was held in Paris, France, from 3 to 5 May 1982. The sponsor, the Acoustics, Speech and Signal

Processing Society of the Institute of Electrical Engineers, changed its name about 10 years ago (from the Audio and Electroacoustics Group) to reflect the growing interest in signal and speech processing made possible by digital computers and the development of the discrete Fourier transform and the fast Fourier transform.

ICASSP 82 was the first such conference held outside the United States, a recognition of European, and especially French, contributions. There were more than 1,600 participants, nearly double the attendance of previous conferences. The number of parallel reviews was increased to 8, and there was a total of 540 papers.

The conference was formally opened by L.J. Libois, president of the French Section of the IEEE, and there were remarks by R.D. Larson, the president of IEEE. In the plenary session, conducted by Maurice Bellanger (Télécommunications Radioélectriques et Téléphoniques, Plessis Robinson), there were three papers on the impact of digital signal processing on society. The first was by Maurizio Decina (Univ. of Rome). Decina is vice chairman of CCITT SG XVII (the International Telegraph and Telephone Consultative Committee); his topic was CCITT activity in signal processing for integrated services digital networks. The networks are intended to support a wide range of services, voice and nonvoice, with end-to-end digital connections and a limited range of standard user-network interfaces. The second paper was presented by Goeste H. Granlund (Picture Processing Lab., Linköping Univ., Sweden), who discussed an approach for hierarchical processing of structural information in artificial intelligence. He gave two illustrations of its application, one to image coding, the compression of image data, and the other to image enhancement. The final plenary paper was by Richard A. Guedj (Thomson-CSF Labs., Courbeville, Orsay) on human-machine interaction and digital signal processing. Guedj asserted that there is a definite need to improve the quality of man-machine interaction and suggested two directions for research. The first is the separation of the symmetric from the asymmetric part in the relationship. (He remarked that good interaction does not necessarily mean fast or close interaction, but meaningful reaction, and that expressions used by each partner should be easily understood, though not necessarily well formed). The second is that the interface should not only be adaptable to the user but also adaptable by the user.

Following the plenary session, the conference was divided into eight parallel sessions of six 15-minute papers, and thereafter the morning and afternoon sessions each contained 12 papers. There were sessions on digital signal processing, audio and DSP applications, underwater acoustics and QSP applications, image processing, speech image systems, speech synthesis and recognition, and speech coding and analysis. The program will be published in

the IEEE Transactions on Acoustics, Speech and Signal Processing and will be available from the IEEE.

As part of the conference there was an exhibition with 20 stands. The object was to avoid the appearance of a large commercial exhibition while adequately covering applications of new technology. Three of the stands were from French national research organizations, CNRS (Centre National de la Recherche Scientifique), CNET (Centre National d'Etudes des Télécommunications), and IRCAM (Institut de Recherche et de Coordination Acoustique/Musique), and most of the other exhibitors emphasized technical rather than commercial aspects. Speech synthesizers were shown by CIT-ALCATEL, CNET, IRCAM, SILEC D.S.I., Texas Instruments, and Thomson-CSF, and analysers by Brüel and Kjaer, France, CNRS, Solartron, and Texas Instruments. CNET had equipment designed to help the handicapped. METRAVIB showed Intensity measuring systems, a multimicrophone directive array for acoustic imaging, and a pipeline leak detector system. There were several displays devoted primarily to software and others to remote terminal displays. Perhaps the most prominent exhibit was of TELETEL, the French remote-test-retrieval system for directory and catalog applications; the closed-circuit TV system of the conference center had a receiver in each meeting room to relay a TELETEL display giving the status of the individual sessions and other messages relating to the conference.

As the IEEE conference proceedings contain only the names of the exhibitors, many of whom may be relatively unknown in the US, the author has prepared an annotated list with addresses; it may be requested from the ONRL librarian.

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#### OPTICAL COMMUNICATION RESEARCH IN SCANDINAVIAN UNIVERSITIES

A particular advantage of using optical fiber in telecommunications systems is that a small fiber cable can transmit vastly greater amounts of information than a much larger electrical cable. Fibers are thus particularly applicable to areas where communications traffic volume and cable densities are highest. The northeast corridor (Boston to Washington) fiber project, now under development by the Bell System, is a good example.

Conversely, one might expect that the Scandinavian countries (including, for present purposes, Finland but not Iceland) with low population densities and remote communities, would not find fiber systems particularly well suited to their needs. One finds, however, that modern communications systems are

particularly important in this part of the world. Sweden, with a population density less than 10% that of West Germany or the United Kingdom, leads Europe in telephones per capita. Denmark and Finland are in the top five. In Finland, roughly one person in 200 has a mobile telephone and the number is increasing at 10% per year. With standardized automatic switching through the Nordic Mobile Telephone Network, available soon, subscribers will be able to use the same mobile telephones throughout Scandinavia. Along with the high demand for services come special problems—long links between isolated trunk exchanges, provision of service to a large number of islands, and difficulties with terrain and weather. Meeting the demand in this environment requires many different techniques, including fibers, perhaps in unpeated trunk or submarine links.

But the demand alone does not explain the existence of strong optical communications research in Scandinavian universities. In the US, where installation of fiber systems now approaches the routine, there are no major programs of optical fiber communications research at universities. The technical universities in Norway, Denmark, and Finland, by contrast, each have a significant program. In Sweden, where there are several technical universities, two are involved. The author visited three of the five recently: the Communications Laboratory at Helsinki University of Technology, the Institute of Optical Research at the Royal Institute of Technology in Stockholm, and the Electronics Research Laboratory at the University of Trondheim. (The others are at Chalmers University in Göteborg and the Technical University of Denmark at Lyngby.)

Helsinki University of Technology (as distinguished from Helsinki University) is at Otaniemi, near Helsinki. Optical fiber research resides mostly in the Communications Laboratory, a part of the Electrical Engineering Department headed by Prof. Seppo Hulme. The group of 30 staff members and research students also undertakes work on radio communications (one sizable project relating to the Nordic Mobile Telephone Network, mentioned earlier) and data communications. In the fiber area the group is best known for its work on precision measurements of fiber parameters. One subgroup, led by A.B. Sharma, has for several years studied the factors that relate to the precision of attenuation measurements on multimode fiber. Emphasizing selective mode detection rather than excitation and with close attention to stability of source and detector, the group claims to have a more complete understanding of the factors causing measurement imprecision than most researchers and boasts results that are several times better than generally available. Similar work is now underway on other measurement problems including differential modal delay. Though measurements dominate the group's efforts on fiber, problems more closely applied to the system—receiver and

repeater design, for example—are also addressed.

To broaden the context, laboratories of the Technical Research Center in Finland, in the same building, are particularly interested in integrated optics and have recently completed a fabrication facility for optical fiber, thus making special fiber and components more readily available to the Communications Laboratory. Another profitable liaison is with the Finnish Post Telegraph and Telephone (PTT), which not only provides support for certain projects but, with its own laboratories nearby, provides other opportunities for collaboration.

In Stockholm, the Institute of Optical Research is one of several research institutes on the campus of the Royal Institute of Technology. Some of the institutes are funded, along with the university, through the Ministry of Education. Others, including the Institute of Optical Research, receive their support through the Ministry of Industry and are, in theory at least, more likely to choose applied topics for research. The research here is not communications but primarily modern optics. In collaboration with the Institute of Physics, there is some outstanding work on the production of holographic diffraction gratings that has yielded efficient, blazed gratings. In another group, work on speckle interferometry has resulted in an advanced prototype instrument for vibration analysis. In all, the staff of one or the other institute concerned with optics numbers about 25.

In the optical-fiber area there is close cooperation between the institutes and Sieverts Kabelwerk, a division of the multinational communications company, L.M. Ericsson. Some members of the staff hold joint positions in the two organizations, and recently the leader of the fiber and integrated optics group at the Institute, Leif Stensland, moved to Sieverts full time to head a section concerned with product development:

It is not surprising that much of the work at the institute is of fairly immediate, rather than long-term, interest to a manufacturer. One area is spectral bandwidth measurements, that is to say bandwidth measured as a function of wavelength, which can be useful in optimizing the refractive index profile of a multimode fiber. Another is differential mode delay measurements—measurement of the relative propagation times of various mode groups—useful for the same purpose. Using a fiber Raman source to provide short pulses over a range of wavelengths and suitable launching optics, the group is able to carry out both types of measurements on a single system and thus provide a great deal of information useful for optimizing process control. At the same time, work on extended-range optical-time-domain reflectometry (OTDR) using a shuttering scheme to extend the dynamic range is particularly useful to cable manufacturers concerned with jointing and splicing.

Finally, members of the group foresee that the adaptation of fiber technology to the remote measurement of various quantities will be important to Swedish industries. Accordingly, with the encouragement of the power industry, they have just begun their first project in this area—an examination of materials suitable for magnetic field measurement by Faraday rotation.

Norway's technical university is in Trondheim. Though administratively separate, the Electronics Research Laboratory (ERL) is centrally located on the university campus overlooking the city, and many of the staff at ERL have academic responsibilities as well. ERL is funded entirely by research contracts from government and industrial sources outside the university.

Two technical areas dominate the group's efforts on optical fibers; one is the investigation of OTDR (sometimes also known as backscattering) as a fiber diagnostic method, the other is fabrication. This turns out to be a particularly useful combination. In OTDR one launches a short optical pulse into a fiber and, while the pulse propagates along the fiber, the part of the light scattered back toward the input is monitored. Some of the light comes from Rayleigh scattering in the glass, but light returned from breaks, joints, and parameter fluctuations also contributes to the signal. When OTDR was first used several years ago, it was thought that it would provide a superior method for fiber attenuation measurements, because the loss as a function of length could be determined. It turned out, however, that the signals were too difficult to interpret. More recently OTDR has been used primarily to search qualitatively for such things as diameter variations along the fiber and other discontinuities. The ERL group has discovered that under certain excitation conditions, known as mode-filtered launching, it is possible to separate the signals due to the basic loss mechanisms—scattering and absorption—from those due to parameter fluctuations and in some cases, at least, to do so quantitatively. This is where the fabrication group, which is normally concerned with such things as more efficient glass deposition, becomes an even greater asset. Testing the OTDR analysis requires fibers with carefully controlled parameter fluctuations, principally diameter and numerical aperture, built in. Using such fibers produced in their own laboratory, Morton Eriksrud and his colleagues have pretty well verified their analysis and have thus made a useful advance in fiber diagnostics.

To return to the earlier question about why Scandinavian universities have successfully established fiber research programs while American universities have not, there seem to be several significant factors. First, national telecommunications administrations in Scandinavia are faced with a strong demand for high technology communications for which, because of their size, they cannot provide sufficient R and D facilities. Supporting university research is

a partial solution. Second, communications companies, though in some cases quite large, also find it advantageous to support university research, especially given the willingness of the universities and the research institutes attached to them to work on problems of fairly immediate application. And finally, governments, concerned not only with the availability of technology for domestic needs but also with export, are inclined to encourage the arrangement.

Within this framework lie also the reasons why each of the groups described has emphasized work on fiber characterization. The production of high-quality fibers requires a certain amount of empiric adjustment of the process; thus, companies setting up production facilities must have reliable data from which to improve their product. Fiber production is also notoriously irreproducible, to the extent that a substantial number of measurements must be made by a manufacturer on each fiber sold and by a user on each fiber purchased. Efficiency, therefore, is almost as important as reliability, and it is likely that applied research on fiber measurements will be important for some time to come.

G.W. Day

University of Southampton

## MATERIAL SCIENCES

### SOME MATERIALS RESEARCH IN SWITZERLAND

The author recently visited several laboratories in Switzerland where materials research is conducted.

Swiss Federal Institute of Technology (Eidgenössische Technische Hochschule-ETH), Zurich

Prof. M.O. Speidel heads the Institut für Metallurgie at ETH Zurich. Speidel is known to many Americans for his work at the Boeing Scientific Laboratories on the application of fracture mechanics methods in stress corrosion cracking research. After leaving Boeing, Speidel became leader of the physical metallurgy group at the research laboratory of Brown Boveri and Company Ltd., Baden, Switzerland, a position he held until his appointment to ETH Zurich about 2 years ago. In Speidel's absence, two of his associates, Dr. H.K. Feichtinger and Dr. P. Uggowitz, outlined current and planned activities at the institute.

For several years Feichtinger has carried out research on melting metallurgy in a well-equipped laboratory capable of handling most modern melting methods, including electroslag remelting. His particular emphasis has been on the analysis of gases in metals, determination of gas diffusion rates in both liquid and solid metals, and assessment of the influence of melting practice on the soundness and properties of alloys. Feichtinger's research has

produced sensitive techniques for determining gases in metals, (e.g., a technique based on gas chromatography capable of detecting hydrogen in the  $10^{-4}$  ppm range).

Uggowitzer came to ETH Zurich in 1981 from the Erich-Schmid-Institut für Festkörperfophysik in Leoben, Austria, where he had done doctoral research on the mechanical properties of ferritic-martensitic two-phase steels. Uggowitzer is still interested in the mechanical properties of two-phase alloys, one phase of which is brittle and the other ductile. Currently he is studying the fracture behavior of alloys of the Al-Si system using the J-Integral measurement to quantify fracture toughness. He is attempting to model the fracture toughness of two-phase alloys in terms of the fracture toughness values of the individual phases and their microstructural geometry.

The research program at the institute is still in the formative stages, but a major thrust will certainly be on determining the effects of melting and solidification practice on the fracture behavior of alloys as measured by fracture mechanics methods.

#### University of Neuchâtel

The Institute for Structural Metallurgy is one of seven institutes in the Faculty of Natural Sciences at the University of Neuchâtel. The institute is directed by Prof. G.W. Form and has a staff of about 14. At the time of the author's visit the building housing the institute still showed signs of damage caused by fire in an adjoining building a year before. Research programs are only now getting back on schedule.

About 50% of the research funds come from the Federal government through the Swiss National Foundation for Scientific Research. The funds are used to support basic research and to pay for the institute's effort as part of a large (five participants from both industry and academe) national program of applied research on high-strength, low-alloy (HSLA) steels. The motivation for the program is the desire to provide the Swiss hot-stamping industry, which represents a large segment of the Swiss metals industry, with 20- to 120-mm-thick HSLA steel strip of a single composition that will have optimum mechanical properties when processed into finished products. The program is entering the fourth year of a 5-year effort and has reached the point at which the participants feel they can specify the steel composition to be used from commercially available German alloys. Processing research on 10-ton quantities is now being carried out. Neuchâtel's part in the program has consisted of mechanistic studies of hot deformation processes and electron microscopic studies of thermomechanically processed material.

Recent basic research at Neuchâtel has involved studies of the causes of fire cracking and recrystallization studies, primarily of Cu base alloys. Fire cracking is the explosivelike

intergranular fracture that can occur when certain cold-worked alloys containing a low-melting phase are heated rapidly for annealing; it can be regarded as a special case of liquid metal embrittlement. Form's research on fire-cracking in Cu-18Ni-19Zn-Pb alloys has convinced him that the sensitivity of an alloy to this type of cracking is dependent on micro-pores around Pb at grain boundaries and impurities that enhance Pb wettability. Current research focuses on the control of Pb wettability by additives.

For several years Form has been interested in recrystallization, particularly the mechanisms responsible for the formation of annealing twins, and he has used photoemission electron microscopy extensively in his studies. As a result of his research, Form has put forward a hypothesis that annealing twins occur during recrystallization so as to provide an easier path for reducing the dislocation density in deformed grains rather than to lower interfacial energy as had been believed for many years.

#### Swiss Federal Institute of Technology (Ecole Polytechnic Federale), Lausanne

EPF Lausanne is the sister Federal Institute of Technology to ETH Zurich. It was part of the University of Lausanne until 1969, when it was incorporated into the federal system. At that time the Materials Department was formed by expanding and modifying a materials testing institute at the university. The department has laboratories devoted to mechanical, physical, and chemical metallurgy, and others for ceramics, polymers, and building materials. There are 8 to 10 candidates for the diploma in materials science and 15 to 20 PhD candidates.

Prof. D. Landolt, who is in charge of chemical metallurgy, has a well-equipped laboratory that permits him to apply both modern surface science techniques and classical electrochemical methods to several interesting problems. For a number of years he has been investigating the process of high-rate dissolution of metals that is especially relevant to electrochemical machining. His recent work in this area has included a study of high-rate dissolution of nickel in the transpassive region using pulsating current, investigation of the role of mass transport on high-rate dissolution of nickel and iron in chloride solutions, and a combined coulometric and Auger electron spectroscopy study of the role of anodic films on nickel during high-rate transpassive dissolution in alkaline nitrate solutions. Landolt also has continued interest in passivation mechanisms in metals and recently completed a study showing the similar behaviors of W and Mo additions to stainless steels for improving pitting resistance. He also has done a limited amount of research on the electrochemistry of cathodic deposition of metals from fused salts. For example, he investigated the role of various metallic electrode materials on the deposition of Na and Al from molten fluorides; W was identified as the

most suitable material for electrochemical studies of Al deposition from cryolite.

Prof. W. Kurz is in charge of physical metallurgy programs. Kurz's particular interest is solidification. He is trying to understand the mechanisms in various solidification processes that are responsible for the development of particular microstructures and to determine how the microstructures contribute to the mechanical behavior of alloys. Kurz has paid special attention to the mechanisms responsible for the development of eutectic structures in Fe-C and Fe-Fe<sub>3</sub>C alloys. He has been working to develop a theory to explain the interphase spacing found in such alloys, which can be 2 to 10 times larger than predicted by current solidification theory. In addition, he recently developed a model relating tip radius, interface undercooling, and primary-arm spacing in alloy dendrite growth that permits a semiquantitative prediction of growth morphology to be expected during solidification in a positive temperature gradient. In the area of structure-property relationships in cast alloys, Kurz has conducted research on fracture initiation in dendritic, two-phase alloys and fracture behavior in eutectic alloys containing brittle phases. Some interesting practical applications have come from this research, such as the development of a directionally solidified cobalt-copper-rare earth permanent magnet with fracture energy five times higher than conventional sintered SmCo<sub>5</sub> magnets and magnetic properties equal to those of PtCo magnets. Finally, Kurz has conducted significant research on practical problems associated with continuous casting of steel. In particular, he has helped to identify the mechanisms responsible for surface roughness of continuously cast steels and has outlined parameters that must be controlled to improve surface quality.

Ceramics research at EPF Lausanne is under the direction of Prof. A. Mocellin. Current programs include studies of microstructural development, microstructural characterization, and microstructure-property relationships. Research on structural development began with studies of such development in Al<sub>2</sub>O<sub>3</sub>, both with and without additives, during hot deformation. In this work, high purity powders with grain sizes of 0.5 to 1.0 micrometers have been hot pressed at 1600°C. Deformation of more than 50% was obtained by a mechanism akin to superplastic deformation, and grain boundary sliding seemed to be the dominant deformation mechanism. These efforts are continuing. At the same time, aluminum titanate formation is being studied. The material is of practical interest because of its inertness to glasses and nonferrous metals and of theoretical interest because its orthorhombic structure and anisotropic thermal expansion behavior make it useful in thermal-shock and thermal-fatigue studies. Mocellin's work with aluminum titanate involves pressure sintering of single crystal discs of Al<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub>, while studying formation reactions at the interface. He has also

been developing a model for computing distributions of grain coordination numbers in polycrystals, assuming that only two elementary transformations, disappearance of three-sided grains and interchange of neighboring grains, take place in the system during normal grain growth and development of stable structures. Comparison of the model with experimental results has been encouraging. Finally, Mocellin is interested in studying microcracking in ceramics resulting from transformations occurring during thermal cycling, e.g., the practical problem of porcelain glaze degradation due to transformations of quartz particles around 573°C. For experimental ease, however, he is studying a system that behaves similarly, V<sub>2</sub>O<sub>3</sub>, doped with Cr. Depending on the Cr content, V<sub>2</sub>O<sub>3</sub> exhibits a transformation around 100°C with sufficient expansion to produce microcracking. Mocellin is using electrical resistivity changes and acoustic emission to follow the transformation and structural changes and is correlating crack initiation with particle size, shape, and degree of cycling around the transformation temperature.

#### Battelle Geneva Research Center

The center is part of the internationally known Battelle Memorial Institute. About 400 persons are employed at Geneva of whom 150 are graduate engineers and scientists. They are distributed among three research centers: Industrial Technology, Toxicology and Biosciences, and Applied Economics. The metallurgy group, headed by Dr. G. Haour, is in the Industrial Technology Center.

As much as 40% of the programs at Geneva are industrially sponsored paper studies involving surveys of the state of current technologies, market trends, etc. An example of this type of program is a cold-forging survey that consists of both a worldwide technology assessment and a European market survey resulting from 200 visits and 300 contacts. Experimental programs consist of fairly short-term projects with decisions to continue or discontinue made at about 6-month intervals. The following are examples of currently active or recently completed research programs: directional solidification studies on nickel-base superalloys, Mar-M-200 and 509, using a patented process of dynamic undercooling that showed the feasibility of producing alloys with structures and properties similar to conventional unidirectionally solidified alloys, but with higher growth rates and using simpler equipment; feasibility studies aimed at the application of amorphous metal coatings to both sides of steel sheets by a melt dragging technique; and development of a new process for producing rapidly solidified powder. The last-named process, currently being patented, is called "quench atomization" and is claimed to be capable of producing spherical powders with diameters of about 10 µm or 1-mm thick splats with cooling rates in excess of 10<sup>3</sup>°C/s.

**Brown, Boveri and Company Ltd., Baden (Dättwil)**

Corporate research, consisting of medium to long-term projects, is carried out in three centers of Brown, Boveri and Company, one in Heidelberg, FRG, one in Le Bourget, outside of Paris, and one in Dättwil, near Baden, Switzerland. The Dättwil center has about 200 employees conducting research in solid state physics, fluid physics, and materials. The materials group of about 30 people is headed by Dr. G. Gessinger, who will leave toward the end of 1982 to head the company's Central Laboratories at Baden.

Materials research at Dättwil falls into two categories, alloy processing and mechanical behavior. Because of the company's interests, most of the materials being studied are high-temperature alloys, titanium alloys, and high-strength steels. However, the laboratory has also had a long-term effort in shape memory alloys aimed at developing alloys with higher transition temperatures than Nitinol. This has led to the development of CuAlNi alloys with transition temperatures of 150 to 200°C. Although the alloy was originally cast with a large grain size and was brittle, research at the laboratory has led to the use of powder metallurgy for its production and complex thermo-mechanical treatment for stabilization. The alloy is currently being licensed in Europe and licensees are being sought in the US.

Alloy processing research has included computer modeling of forging processes and experimental analysis of isothermal forging using model alloys. In the latter study, the influence of preform geometry on deformation flow, die filling, and uniformity of deformation in isothermal forging has been studied using a Sn-38.1 w/o Pb eutectic. This alloy, which deforms superplastically at ambient temperatures, was found to be useful for modeling superplastic processes in materials that normally would be superplastic in the 800 to 1,000°C temperature range. For example, the findings of the research were in close agreement with subsequent findings of the role of preform geometry on deformation flow patterns in Ti-6Al-4V forged at about 925°C.

A significant amount of the processing research of Gessinger's group has involved oxide dispersion strengthened (ODS) superalloys. The work on these materials, produced by mechanical alloying, has focused on their recrystallization behavior as a function of deformation, annealing, and hot working conditions, and the role of the oxide dispersoids on grain growth. Gessinger feels that good progress has been made over the past decade, especially with the newer high γ' alloys, and he believes that they offer great promise for turbine applications despite their higher cost and the more complex schedules required for processing them.

Gessinger's present programs do not include research on rapidly solidified powders, but an atomizer to produce such powders will

soon be installed. Initial programs will probably be concerned with the development of new Al alloys with extended solid solubility in an attempt to increase the service temperature range for Al alloys.

Current investigations of the mechanical behavior of alloys include high-temperature, low-cycle fatigue studies of nickel-base alloys, development of models for fatigue lifetime prediction, improvement in fracture toughness analysis in the elastic-plastic and plastic regimes, and corrosion fatigue and stress corrosion cracking of turbine materials using a fracture mechanics approach.

P.A. Clarkin

ONR London

## MATHEMATICS

### THE FOURTH FORMATOR SYMPOSIUM

The Fourth Formator Symposium on Mathematical Methods for the Analysis of Large Scale Systems was held in Liblice, Czechoslovakia, during the period 18 to 21 May, 1982. (A formator was defined as a device in a system that acts on system variables to help control the system.) There were 47 participants from 11 countries, including Austria, Brazil, Czechoslovakia, the FRG, France, the CDR, The Netherlands, Vietnam, the United Arab Republic, the US, and the USSR. Thirty-seven papers, covering a wide range of system-control topics, were presented. The proceedings will be published by the sponsor, The Institute of Information Theory and Automation of the Czechoslovak Academy of Sciences, (address: 182 08 Praha 8, Pod vodárenskou věží 4, Czechoslovakia).

The keynote address, "On Qualitative Analysis of Information For Control," was delivered by A.A. Voronov (Institute of Systems Study, Moscow). Voronov treated the processing of observer information (expert detections) for use in controlling systems. He discussed the problems of using observer data to find estimates and of "organizing experts" (which he proposed to do via statistical cluster analysis).

Approximately half of the presentations dealt with mathematical methods for the solution of systems of equations related to control problems. As one example, the paper entitled "Continuous-Time Dynamic Programming Models," by W.H.M. Zijm (Universiteit van Amsterdam, The Netherlands), discussed the behavior of systems of the form

$$\frac{dx(t)}{dt} = \max_Q x(t); \quad x(0) = x, \quad t \geq 0,$$

where  $x(t)$  is an  $N$ -dimensional vector and  $M$  is a set of matrices generated by all possible interchanges of rows within matrices taken from a finite set of ML-matrices. An ML-matrix is a square matrix with nonnegative off-diagonal elements.

The above model covers many situations in Markov decision processes, queuing systems, branching processes, and Leontief substitution systems in mathematical economics. A system described by the model can be controlled continuously in time to maximize the growth of the function  $x(t)$ . Such a system has a unique solution that is continuous and satisfies the differential equation almost everywhere (R. Bellman, *Dynamic Programming*, Princeton Univ. Press, 1957). Zijm concentrated on the asymptotic behavior of  $x(t)$  and on methods of determining an optimal control (that is, matrices in  $M$  that maximize the growth of  $x(t)$  in time). He presented an exponential convergence result for undiscounted, continuous-time Markov decision processes and pointed out that the result is useful in analyses of more general models.

About a quarter of the presentations treated the development of mathematical models for various physical systems. One such paper was "The Shaping and Reconfiguration of Polyhedral Diagrams," by J. Beneš, who heads the Operations Research Sector of the Institute of Information Theory and Automation (Prague, Czechoslovakia). Beneš discussed the analysis of sets of vectors representing thrusters or flywheels used to generate desired attitude changes of a satellite in space. He considered systems of vectors perpendicular to faces and edges of a dodecahedron and other regular solids. Using combinatoric methods, he evaluated the number of ways to generate certain forces on a space body. Beneš called the collection of such values the spectrum of the body. An application of this work would be to prestore vectors in a formator that would automatically reconfigure thrusters on a satellite in such a way as to work around failed thrusters.

The remainder of the papers presentations were reports of specific applications to operating systems. They included a paper entitled, "Analysis and Synthesis of a Coal-Mine Winding System by Computer Assisted Simulation," by M. Přeučil and Z. Šebela (Stavební Fakulta ČVUT, Prague). According to the authors, multirope winding systems in deep mines are characterized by complicated dynamical behavior of the skips and winding mechanism. The purpose of their study was to examine the potential effects of introducing a formator unit into the winding system control by assessing the improvements that might be possible and evaluating the design characteristics (inputs, outputs, and control equations) of the formator. As a preliminary step, rope tension measurements were made on the multirope system at a coal mine in Czechoslovakia. A device placed on one of the two skips used in the system was

used to measure horizontal forces between the skip and rails in the shaft, flexing of the steel walls of the skip, acceleration of the skip in three dimensions, and oscillations in the winding ropes. Another device in the engine room measured torque moments of the engine shaft and parameters of the electrical drive of the winding machinery. All of the measured quantities were functions of time and of position and movement of the skip. The data were used to analyze transients and reasons for observed dynamic behavior of the system. A model, involving a system of nonlinear differential equations, was developed to describe the behavior of the system and was validated by comparison of numerical solutions to the equations with the measurement data. One of the difficulties encountered was the discovery that some of the ropes carried much more load than others, due to differences in friction-wheel diameter and rope creep on the friction wheel.

From extensive analyses carried out with the mathematical model of the system, it appears possible to design a formator that will bring a number of improvements to coal-mine winding systems. The anticipated improvements include the removal of the heavy rope-balancing device currently used on each skip, dramatic decreases in the weight of each skip, increases in the skip loads, and increases in the winding rates.

While the symposium was small, the material presented was interesting, useful, and of good quality. The sponsors did an excellent job of organizing the meeting and ensuring that the sessions ran smoothly.

D.R. Barr

ONR London

#### THE INTERNATIONAL MEETING ON ANALYSIS OF SAMPLE SURVEY DATA AND ON SEQUENTIAL ANALYSIS

The International Meeting on Analysis of Sample Survey Data and on Sequential Analysis was held on the Mount Scopus campus of The Hebrew University of Jerusalem during the period 14 to 18 June, 1982. Among the 13 organizations sponsoring the event were the US Office of Naval Research and the Israel Statistical Association. There were more than 100 attendees from 16 countries. While the areas of sample survey methods and sequential analysis are usually treated as being quite distinct, they do have some common features; one of the goals of the meeting was to explore the similarities in the two procedures. This was done in a joint session on the first day. During the remainder of the meeting, there were parallel sessions on analysis of sample survey data and on sequential analysis.

An interesting paper in the joint session was "On Triple Sampling Schemes for Categorical Data with Misclassification Errors," by T.T. Chen (Univ. of Texas), Y. Hochberg

(Tel-Aviv Univ.), and A. Senenbein (New York Univ.). There had been much previous work on the use of double-sampling schemes for inference from categorical data that are subject to misclassification. Some of these schemes use a sample of  $n$  units that are classified by both a fallible and a "true" device, and another sample of  $n_2$  units that are classified only by a fallible device. The authors treated a triple-sampling scheme incorporating an additional sample of  $n_1$  units that are classified only by the true device. They considered the problem of optimal allocation of sample sizes for triple sampling, which would minimize the cost of achieving a given variance of estimation of a binomial parameter. The authors concluded that under many circumstances, either a single or double sampling scheme could be used. The problem of determining maximum likelihood estimates under various misclassification structures was also discussed.

The sequential analysis sessions concerned sequential selection and multiple comparisons, Bayesian and optimal sequential procedures, sequential detection of change, sequential testing, and bounded and truncated sequential procedures. Worthy of note was the presentation "On the Reduction of Optimal Decision Problems to Optimal Stopping Problems in Continuous Time," by V. Mammitzsch and R. Rhiel (Fachbereich Mathematik der Philipps-Universität, Marburg, Germany). For many sequential-decision problems in continuous time, the problem of finding an optimal sequential-decision procedure can be reduced to an optimal stopping problem for a certain stochastic process  $\{X_t\}$ . The authors used Martingale theory to establish conditions under which the process has continuity properties that yield the existence of an optimal stopping time. They showed that in some cases, for example, where the terminal decision is based on observation of a stochastic process such as a Gaussian process with independent increments, an explicit representation of  $\{X_t\}$  can be given. The authors indicated that explicit solutions of the optimal stopping problem can be found in various special cases.

The sessions concerning analysis of sample survey data included papers on categorical data analyses, design effects for complex statistics, analyses based on time-related models, imputation and analytical treatment of non-response, analyses for survey design strategies, the use of auxiliary information in model-based analysis, applications of analytical techniques to sample survey data, and design of analytical surveys. One of the papers in the analysis of sample survey data sessions was "A Simulation Comparison of Estimators for a Regression Coefficient under Differential Non-Response," by G. Nathan (Hebrew Univ., Jerusalem). Nathan discussed the estimation of a regression coefficient in a linear regression when observations are missing due to nonresponse. He assumed that response is determined by a nonobservable

variable that is linearly related to an observable variable. The values of the observable variable are assumed to be available for the whole sample, but the variable is not included in the regression relationship of interest. Several alternative estimators have been proposed for the situation, including a two-stage estimator (Heckman, *Econometrica*, 1979) and others based on a sampling theory approach. In the latter case, the observations are viewed as being obtained from a subsample, selected on the basis of the observable variable (Nathan and Holt, *Journal of the Royal Statistical Society, Series B*, 1980). A simulation comparison of the estimators and the ordinary least squares estimator was presented, based on expressions for their conditional biases and variances under the assumption of multivariate normality of all the variables involved. The results indicated that the two-stage estimator is not robust, while the other estimators are similar to each other in robustness. It was also indicated that, in terms of mean square error, the sampling-theory-based estimators have little advantage over the ordinary least squares estimator.

The participants had the opportunity to visit the Central Bureau of Statistics. Dr. Moshe Sicron, government statistician and scientific director of the bureau, presented an overview of Israel's national statistical system, which is concerned with statistical support for virtually all government activities in Israel. Examples include sampling to provide information about housing, maintenance of cost-of-living indices, and health-care-system statistics. Development and maintenance of data bases in areas of interest to the government and research on statistical methods are also undertaken by the bureau. Sicron said that there is close cooperation between the bureau and statisticians in Israeli universities.

D.R. Barr

ONR London

## SPACE SCIENCES

### THE EUROPEAN SPACE AGENCY AND THE PROPOSED KEPLER MISSION

European space programs are in increasing measure determined by the European Space Agency (ESA). ESA was formed in 1975 as an outgrowth of earlier cooperative space organizations and has 11 member nations. Its primary objective is to provide and to promote cooperation among European nations in space research, technology, and applications for exclusively peaceful purposes. Not surprisingly, ESA is a complex organization with regard to administrative structure, governing procedures, operations, and budget (which approximated \$850 million in 1981). To fulfill its mission,

ESA aims to elaborate and implement a long-term European space policy and a European space program, progressively "Europeanize" the separate space programs of the member states, particularly in regard to applications satellites, and elaborate and implement an industrial policy.

Many of ESA's scientific activities to date have been in close cooperation with the United States through participation in NASA missions. The largest undertaking of this sort has been Spacelab, designed and developed by ESA at a cost exceeding \$1 billion, which is scheduled for an early Shuttle launch. With the development and recent successes of Ariane, however, ESA now has an independent launch capability with impressive payload capacity even for deep space exploration. The new launch capability is a major step towards space parity and enables the European conglomerate to conduct "pure" ESA space missions with full independence of the US and USSR. Indeed, dissatisfaction in the European sector regarding the reliability of international space program agreements may spur the occurrence of such "pure" mission activity. Of course, the ability to conduct an independent space program is also essentially one of the declared aims of ESA.

Completed ESA space projects have been broadly based, imaginative, and of high quality. Projects currently under development include several novel missions that will refine and advance our knowledge in certain areas (e.g., the position and structure of X-ray sources and improvements in astrometry) or venture into totally new areas (e.g., the Giotto mission to Halley's Comet and the first out-of-the-ecliptic mission to explore the regions of space over the poles of the sun).

Planning efforts at ESA for prospective future space missions continue to build upon the US program and to complement planned or likely US initiatives. This is a sound approach that will clearly serve to advance our collective scientific knowledge most expeditiously. One planning effort, which is independent of any US initiative and is briefly described in the remainder of this article, is the so-called Kepler mission to Mars. Kepler does not have the status of an approved ESA mission and, indeed, will have stiff competition from other quarters before achieving that status. Kepler would be a pure ESA mission requiring no more than current Ariane launch capabilities.

The Kepler mission is an engaging one for two reasons: (1) It is configured instrumentally and fiscally in a manner shown to be successful by NASA; (2) It gives high priority to planetary exploration and this appears to be contrary to the planning trend in the US space program. NASA's recent retreat in the planetary exploration area was prompted by budgetary problems—many of which related to the Shuttle—and other factors still widely discussed in the scientific community. One approach that many US space scientists have recommended in the interest of economy and

maintaining a viable planetary exploration program has been to create a "Planetary-Explorer Program." The Explorer satellite program has operated continuously since the earliest days of the US space program and includes among its many successes the discovery of the Van Allen radiation belts. In essence, the Explorer program provides for low-cost, highly focused satellite missions designed to address rather specific scientific questions. By no means have Explorer missions been "poor-boy" or second-class efforts, but their scope and cost are by design limited. In addition to its scientific merit, the Explorer program has provided a continuity of effort for many research groups, and this has been crucial in actually maintaining the scientific community involved. In many ways, the proposed Kepler program fits the description of a Planetary-Explorer mission.

The Kepler mission would place a satellite in Mars orbit, with the objectives of determining or exploring the planet's magnetic field, magnetic interaction with the solar wind, plasma environment, aeronomy, meteorology, climatology, topography, gravitational field, and interior structure.

Mission objectives and planned experiments build upon previously obtained results on Mars and address major questions or uncertainties that have evolved. For example, the magnetic field of Mars has been the subject of much controversy and the polar regions have been largely unexplored.

The satellite orbit would have a large inclination with respect to the ecliptic to allow for good viewing of the polar regions. The orbital period would be set at 4.8 hours corresponding to five rotations per Earth day. Periapsis would correspond to an altitude of 130 km and apoapsis to 3.1 Mars radii (7,100 km). The mission lifetime would be 1.1 Mars years (about 2 Earth years) allowing for complete coverage of planetary local time in the course of the mission. The proposed mission-launch date is 17 July 1988 with Mars encounter on 9 January 1989. The next solar maximum will be in 1991, when the mission would end. In transit to Mars, Kepler would monitor the solar wind.

Kepler design features would use the successful experience of the recent US Pioneer-Venus mission. Thus, Kepler would be a low-cost planetary mission (~\$150-200 million), carrying 10 instruments with a total mass of 45 kg and 50 watts power. The planned transmission rate is 1 k bits/sec. The satellite would be spin stabilized with the spin axis oriented towards Earth with a pointing accuracy of about  $\pm 0.15^\circ$ , all simple and easily achieved design conditions.

*R.L. Carovillano*

ONR London

## EUROPEAN X-RAY ASTRONOMY

The US Naval Research Laboratory (NRL) conducts collaborative work with organizations in various countries as part of its program of space sciences. Recently the author and Dr. Raymond Cruddace of NRL visited three such establishments in Europe: the Institute for Extraterrestrial Physics of the Max-Planck-Institut (MPI) in Garching, FRG; the Mullard Space Science Laboratory (MSSL) of University College London; and the Physics Department of the University of Leicester, UK. This is a report of the visits and a general discussion of the status of X-ray astronomy in Europe.

This year will mark the 20th anniversary of the discovery, during a sounding rocket flight from the White Sands Missile Range in New Mexico, of X-ray emission from beyond the solar system. The discovery was a result of deliberate policy by the US Department of Defense to support basic astronomical research at high altitudes that had begun more than a decade earlier using balloons, rockets, and orbiting satellites. The X-ray-discovery flight was carried out in 1962 by a group of scientists at American Science and Engineering, Inc., Cambridge, Massachusetts, under contract to the US Air Force. Pioneering work in the same general area had been carried out at NRL (e.g., the discovery and study of X-ray emission from the sun).

Additional exploratory work was carried out under Navy and Air Force sponsorship in the 1960s. Eventually the bulk of the activities were sponsored by NASA; however, even now X-ray astronomy is being conducted at NRL under joint Navy and NASA sponsorship.

The basic discovery in X-ray astronomy is that there are classes of objects and phenomena in the universe, hitherto undiscovered, that produce X-rays in prodigious amounts. The first source observed, Scorpius X-1, is  $10^4$  times more luminous than the sun, virtually all of the luminosity being in the form of X-rays. By contrast, only one millionth of the sun's luminosity is at such wavelengths. Scorpius X-1 and other strong X-ray sources are now known to be double-star systems containing a collapsed star, neutron stars or white dwarfs, and possibly black holes. In such stars, the matter has been condensed to forms that are unobservable from earth. In a white dwarf, the density is  $\sim 10^6$  that of ordinary matter and electrons are totally separated from their parent atoms. In a neutron star, the matter density is  $\sim 10^{12}$  that of ordinary matter and both electrons and discrete atoms have disappeared, leaving only a dense gas of neutrons. Neutron stars were first seen as the radio pulsars.

Only the nuclear force is operating to provide pressure balance in a neutron star. If the pressure due to gravitational attraction were to increase further (e.g., by addition of more mass to the star) the nuclear forces between the neutrons would be exceeded and the object would collapse to yet another state,

the black hole, in which the entire matter of the star is concentrated into a microscopically small volume. There is evidence that at least one X-ray source, Cygnus X-1, may contain a black hole. This state of matter may be representative of conditions in which the universe originated.

In addition to the above objects, it has been found that ordinary stars in our galaxy are much brighter in X-ray emissions than had been expected, that shock waves generated in the interstellar medium by supernovae can produce X-rays for thousands of years after the initial explosion, and that the object existing at the very center of our galaxy is a source of X-rays. Indeed, almost every kind of astronomical object in the galaxy is now seen as an X-ray source at some level.

Outside the galaxy, X-ray emission is observed from another diverse set of objects including normal galaxies and the gas that occupies the space between individual galaxies in clusters of galaxies. Also, active galaxies, Seyfert galaxies, and quasars are strong sources of X-rays and make up much of what once was seen as a diffuse, uniform background of X-rays.

Overall, the conditions that lead to X-ray emission, notably large regions of million-degree plasma, are a pervasive feature of the universe—existing around stars and at the centers of galaxies, in the region between the stars, and in the region between the galaxies. Furthermore, nature has found ways, not fully understood, to store and release energy explosively in the form of X-rays in amounts that dwarf most other astronomical phenomena and on time scales from seconds to months.

The US space research X-ray effort has been concentrated in a number of satellite experiments: Uhuru, SAS-3, HEAO-1, and the recently completed EINSTEIN Observatory Mission. The last-named comprised a large grazing incidence telescope for focusing X-rays, along with imaging and spectroscopic instruments in the focal plane. This complement of instruments yielded sensitivity improvements of three orders of magnitude; it also produced astronomical pictures of a quality comparable to those normally achieved in visible light.

A significant effort in X-ray astronomy has been emerging in Europe. The national space programs in the UK and Holland provided small satellites dedicated to X-ray astronomy (Ariel 5 and 6, ANS). The European Space Agency (ESA) will launch its first satellite dedicated to X-ray astronomy (EXOSAT) late this year. The FRG national program is centered on ROSAT, an X-ray telescope mission with imaging capability comparable to that achieved on EINSTEIN. ROSAT will also carry a pair of telescopes, supplied by the UK, that will operate in the soft X-ray range (50 to 200Å). Other missions in the area of X-ray astronomy have been proposed to ESA and to the UK and FRG for their national programs. National groups in Denmark, France, Holland, and Italy also are

involved in X-ray astronomy and in space astronomy generally. Although the European program is based principally on the Ariane launch vehicle, certain of the national missions will make use of the US Space Shuttle.

The Europeans have a strong program in other space astronomy disciplines, including a major astrometry mission, HIPPARCOS. They have also benefitted substantially from being able to participate in the US space science program. European instruments are flying as part of the Solar Maximum Mission (SMM) and the International Ultraviolet Explorer (IUE) and are planned for the Gamma Ray Observatory (GRO) and the Space Telescope (ST). In addition, individual experiments will be part of the Spacelab program on the Shuttle. Europeans often have been allowed to compete freely for opportunities on US satellites.

MPI has a broad program of space sciences, including gamma-ray astronomy, infrared astronomy, and magnetospheric investigations in addition to its X-ray astronomy program. In the space of a few years, MPI has achieved the status of one of the important institutions in the world conducting space science, with significant scientific discoveries and technical advances. The West German scientists appear to be trying to leapfrog their scientific competitors by attempting to develop advanced instruments. Clearly this is a high-risk approach, but the scientific payoff would be substantial in those areas where they were successful. For example, in the area of X-ray astronomy they are concentrating on the development of large-aperture, high-quality, X-ray optics. In addition, they are developing transmission gratings for use at X-ray wavelengths that are perhaps the best being produced in the world today. In the area of gamma-ray astronomy, MPI scientists have pioneered in the development of the Compton telescope, now scheduled to fly on NASA's GRO mission. This device is acknowledged to provide the best angular resolution (imaging) for gamma-rays in the MeV range. In infrared astronomy, the major thrust is in the area of very high resolution spectroscopy using superheterodyne techniques and Michelson interferometers. Also in the infrared, the Germans are pursuing a space mission that would use a liquid-helium-cooled telescope (German Infrared Laboratory, GIRL).

The UK has been involved in the space sciences ever since the capability to carry payloads to high altitudes developed in the 1950s. As in the US, interest stemmed from scientific activities begun before World War II involving the ionosphere and solar activity. The groups at MSSL and the University of Leicester have major responsibility for space experimentation in the UK. Important experimental activities are also being carried out at Birmingham University, University College, London, the Appleton Laboratories, and the National Physical Laboratory. There is strong theoretical support at Oxford and Cambridge universities. An important element in the UK program is

geographic compactness—the institutions are within a few hours drive of each other. It is as if most US space science (including NASA) were concentrated between Boston and Hartford in New England or between San Francisco and Monterey in California. As in Germany, the UK space program has both a strong national component and an important involvement in both the European and US programs.

The research at MSSL, about 25 miles from London, is directed by Prof. R.L.F. Boyd, one of the notable pioneers in the space sciences. The scientific activities are concentrated on solar physics and X-ray astronomy in the soft X-ray regime. With the Lockheed Corporation, the laboratory has responsibility for a high resolution X-ray spectrometer on NASA's Solar Maximum Mission. With the University of Leicester, it will be providing the instrument to fly on the West German ROSAT mission, namely a grazing incidence telescope designed to operate in the XUV range. As with other space science groups, Boyd and his people suffer from the general decline in space opportunities. Thus, they expect more of their activities in the future will be in applications and are making an effort to develop devices for oceanography.

The space science activity at the University of Leicester is centered in the Physics Department. The effort is directed by Prof. Kenneth Pounds and is principally in the area of X-ray astronomy. With MSSL, the department has had an important role in developing hardware for ESA's EXOSAT mission and will be a major participant in its use. EXOSAT has an interesting history. It was conceived as a high ellipticity mission to observe lunar occultations of discrete X-ray sources, as occultations provide a powerful means of obtaining very precise positions. Such one-dimensional maps of astronomical objects have been used in both radio and optical astronomy. However, only a limited number of objects can be examined in this way. Since originally conceived, the requirement for precise positions has been met by other techniques and the EXOSAT mission has evolved to allow for monitoring X-ray sources with a large-area detector and conducting other source studies with a grazing incidence telescope. One unique feature of the mission is that about 40 hours of continuous viewing of single objects would be available because the high orbit limits earth occultation. On the other hand, the background radiation would be significantly higher for EXOSAT than is encountered in the low-altitude orbits normally used in X-ray astronomy missions.

The major new initiative of the group at Leicester will be providing hardware for the ROSAT mission. In addition, the group has a history of collaboration with US groups, e.g., it is currently working with X-ray astronomers at MIT on a sounding rocket program.

The Europeans are pursuing the space sciences, especially X-ray astronomy, aggressively. They recognize the high scientific

return in the space sciences and the rewards of having a strong program of X-ray astronomy. With EXOSAT and ROSAT they have opportunities not available to US scientists—the next major US mission, AXAF (an observatory class facility using grazing incidence telescope), has not been approved by Congress yet and probably could not fly until 1990 at the earliest. The European outlook can be summarized by the following paragraph that appeared in the British journal *New Scientist* (Nigel Henbest, 18 March 1982, p. 724): "Until the mid-1990's, the way is clear for the Europeans to lead in X-ray astronomy, and possibly in that period to build up a lead which will be unassailable by the time that another major X-ray observatory—American or Japanese—is launched. After two decades of solid work, which in the public eye at least has always seemed half a step behind their transatlantic colleagues, European X-ray astronomers are now emerging—just a little dazed—from the American shadow into the sunshine of world leadership."

H. Gursky

NRL Washington, DC

## NEWS & NOTES

### MOD TO CHANGE ITS WAYS

The Ministry of Defence (MoD) in Great Britain is the approximate equivalent of the US DOD, but it also vests within itself the roles of the research offices and technology procurers of the US military services. Inflation, being a respecter of neither persons nor organizations, is striking hard at the MoD. In addition, product sophistication and versatility requirements are accounting for an additional 10% over and above inflation. A straight line extrapolation of the MoD defense budget as a constant percent of the expected gross national product has been made by Lord Trenchard, Minister of State for defense procurement. In his projection, the Royal Navy will be down to one frigate and the Royal Air Force down to a single combat aircraft by the year 2000. Clearly, changes are required.

To combat the trend in the near term MoD has instituted an eight-point plan directed toward improved planning and management. For the longer term MoD seeks (1) greater industrial participation in funding to be balanced by export sales, (2) a critical examination of the research program to ascertain that priorities are in accordance with MoD equipment policy, and (3) greater specialization of R&D with consideration for reducing the spectrum of capabilities and concentration on a more limited range of weapon technologies. (excerpted from *Electronics Weekly*, No. 1124, 7/7/82)

M.R. Yoder

ONR London

### COMITE ARCTIQUE INTERNATIONAL AND THE FRAM STRAIT PROJECT

The Comité de Arctique International (CAI) was founded in Monaco in 1979. It is a multi-disciplinary, non-governmental organization dedicated to increasing knowledge and understanding of the Arctic region. It is concerned with promoting Arctic research and development activities in a manner similar to the Scientific Committee for Antarctic Research (SCAR). The CAI advises, supports, and reviews the activities and programs of other organizations having interests in the Arctic, and it sponsors research programs on its own.

The CAI is currently administered by an 8-member Executive Committee (including controller and treasurer) and a 12-member Council. The members come from Denmark, Iceland, France, Canada, United Kingdom, Federal Republic of Germany, Japan, Greenland, Sweden, United States, and Monaco. The Council meets semiannually; the Executive Committee may meet more frequently.

One function of the CAI is the sponsorship of conferences. These have included "The Arctic Ocean-The Hydrographic Environment and the Fate of Pollutants," held at the Royal Geographic Society, London, in March 1980, and "The History and the Discovery of the Arctic Regions as seen through the Work of Cartographers from Early Antiquity to the 18th Century," held within the Vatican State, Rome, in October 1981. On 22-24 September 1982, the CAI will sponsor a conference in Oslo, Norway on "Arctic Energy Resources; and in May/June 1984 it will sponsor a conference in Stockholm, Sweden on "Medical Problems of Diving and Underwater Operations in Arctic Areas."

The first major research project to be undertaken by the CAI will concentrate on the Fram Strait between Greenland and Svalbard. The project will include sea ice and heat budget studies. Planning is well underway, but the time frame for the project has not yet been fixed, pending negotiations for funding.

The CAI produces a newsletter. The first issue was published in May 1982 and provided the information given above. For further details, readers should contact the secretariat in Monaco: 16, Boulevard de Suisse, MC-98000 Monte Carlo, Principality of Monaco.

LCDR R.W. Booker

ONR London

### ACOUSTICS AT GRENOBLE, FRANCE

The Centre d'Etude des Phénomènes Aléatoires et Géophysiques (CEPHAG) is one of four laboratories of the Ecole Nationale Supérieure d'Ingenieurs Électriciens de Grenoble (ENSIEG), itself a part of the Institut National Polytechnique de Grenoble (université). It is at the Domaine Universitaire at Saint-Martin-d'Hères, an eastern suburb of Grenoble.

Prof. Jean-Louis Lacoume, the director of CEPHAC, has a staff of 24 research scientists and 10 engineers, technicians, and supporting staff. There are also several students for the DEA (Diplome d'Etudes Approfondées), roughly corresponding to the US master's degree. Activities are primarily in signal processing with applications to underwater acoustics and geophysics.

Dr. Geneviève Jourdain heads a group concerned with the characterization of the medium for underwater acoustic communication. The group is attempting to model transmission between two points in the ocean in terms of a linear filter that operates on the transmitted signal to form the signal that is actually received. The filter model must take into account frequency dispersion in the medium at multipath transmission and may vary with time. When the transmission properties of the medium have been adequately described, they hope to be able to process the received signal in such a way as to improve the accuracy of reproduction for a binary-coded transmitted signal. The work is partly theoretical and partly practical. They collaborate directly with the Marine Laboratory at Le Bruse and also with the UK Admiralty Underwater Weapons Establishment (Drs. Westen and Pyelt) and with a Norwegian defense establishment.

A second group, headed by Lacoume, is concerned primarily with different signal-processing and spectral-analysis schemes. They are concerned with both classical and parametric methods and adaptive processing of stationary and nonstationary signals. They have developed a series of plug-in modules for high-speed modeling of different functions, somewhat on the principle of an analog machine, but carried out numerically, with many bits for high accuracy.

A third group is concerned with the physics of propagation in different media, including the ionosphere and the magnetosphere as well as in a marine environment.

Also on the campus is a regional establishment of the Centre Scientifique et Technique du Batiment (CSTB). Under the direction of Mr. Robert Jasse, CSTB has about 50 people, half in acoustics and half in the physics and chemistry of construction materials, particularly with regard to aging and fatigue. In psycho-acoustics they are studying the effect of noise on people, particularly noise from two-wheeled vehicles (mopeds), using a listening room originally set up in connection with the Concorde program. A pair of separately isolated but adjacent rooms is used for studying the transmission of different wall constructions, though flanking transmission is still a problem. Another large room with a replaceable end wall is used for studying infrasound effects, for which a loudspeaker is used as a source from 20 to 50 Hz; a large vibrating piston between 2 and 20 Hz, and below 2 Hz a large fan whose speed is controlled through an amplifier. Studies on the transmission of noise in water

pipes and transmission through silencers are just beginning. The most important facility is a room in which models of urban location on a scale of 1:100 or 1:200 are erected to predict the effect of new road construction and other civil engineering projects on the acoustic environment. It is equipped with a computer-controlled probe to sample the three-dimensional sound field. The studies are usually solicited in the planning stages of specific projects; though I saw several detailed reports they do not usually appear in the general scientific literature.

G. L. Wilson

Pennsylvania State University

#### MICROPROCESSORS THAT CAN SMELL?

In a recent move Imperial College London has transferred its experimental fermentation plant to a private company. The college is now in the market for three new faculty members - one professor and two lecturers, all three to be paid by noncollegiate sources. One result will be a Center for Biotechnology, of which Prof. Brian Hartley will be chairman. Thus the fermentation plant, which was not very useful to the college, has been marketed and, in effect, converted to a new research center.

Hartley foresees two lines of research for the new center. One is the development of microorganisms that can digest wood and other materials and convert them into useful chemicals. The other is the development of enzyme electrodes or sensors so as to couple the activity of biochemical enzymes directly to a semiconductor device. Hartley says they may be able to make microprocessors that can smell. (From Nature, 297, p. 618, 1982.)

F.A. Richards

ONR London

#### FUNGI FOOD FROM HIGH WYCOMBE, ENGLAND

One of the more promising micro-organisms is the A3/5, a Fusarium fungus that was originally found in the soil near High Wycombe, England. When suitably grown on a feed stock such as wheat or potatoes, A3/5 yields a consistent product of about 45% protein, 13% fat, and 22% dietary fiber. These levels resemble those found in beef, and according to John Elkington of Environmental Data Services, Ltd., London, UK, the material can be flavored to taste like chicken and veal and made into imitation drumsticks and chops. A mixture of A3/5 and real fish also makes a satisfactory fish stick. The growth process is efficient: each kilogram of carbohydrate yields 1.08 kilograms of wet food product and 136 grams net of

protein. A chicken fed on the same carbohydrate would yield only about 50 grams protein.

Production of A3/5 has been developed past the pilot plant stage and is now ready for scaling up. UK's Rank Hovis McDougall (RHM), which owns the patents, has used A3/5 in many animals and has also carried out volunteer trials with humans; the results with humans are encouraging, with only one minor negative reaction reported in some 400 people. As Elkington observes, useful microorganisms have been found in strange places: the source of cephalosporium antibiotics (which are now outselling penicillin) originated in a sewer outfall in Italy, and recently it was found that a bacterium from the hot springs of Yellowstone Park could convert xylan (a sugar found in woody plants) into ethanol.

*N.A. Bond, Jr.*

ONR London

#### JAPANESE AND AMERICAN IQ SCORES

Japan now has the highest "Wechsler IQ" of any nation in the world. This conclusion comes from Richard Lynn, of the New University of Ulster, Londonderry, UK. Reporting in *Nature*, Lynn compared the results from a sample of 1,100 Japanese children (100 at each age level 6-16) with American score norms on the Wechsler Intelligence Scale for Children (WISC). The obtained Japanese mean is now about 111, compared to American mean norms slightly above 100. Furthermore, there are rather consistent Japanese superiorities across many cohorts; when Lynn plotted test results over the past six decades, although various samples of Japanese have always tended to show slightly higher scores than Americans over the years, the results showed that the disparity is apparently increasing. The Japanese testees born before 1946 scored only a few points higher than their American counterparts, while those born since 1946 tended to show a greater superiority, which is now on the order of 10 points.

A simple-minded look at Lynn's numbers indicates that Japan has raised its child IQs by seven points over the last generation. As this increase is measurable among 6-year-olds, it is probably not due directly to the educational system, but to such factors as nutrition and home "early achievement pressure" on Japanese children.

If the criterion of "giftedness" is set at a WISC IQ of 130, then nearly 10% of Japanese children would qualify, compared to about 2% of American or West German children. Another way Lynn puts it is that, assuming data adequacy and taking populations as a whole, about

77% of Japanese children have a higher IQ than the average American child.

Dissemination of these findings has already inflamed many critics in Britain, and every cohort study cited by Lynn can be contested on some ground or other. The stock criticisms against any mental testing have been reiterated in the British press. As computerized testing gets cheaper and better, we can expect further research in this arena to be superior on technical and sampling grounds, but we should not expect the test scores themselves, or their social meanings, to be free of controversy. In any event, the alleged Japanese-Western disparity will continue to engage the attention of many analysts and educators.

*N.A. Bond, Jr.*

ONR London

#### SCRAMBLED CALVES

For perhaps the first time, calves have been produced that genetically have two fathers and two mothers. The experimental work was done by Steen Willadsen and Carol Fehilly at the Institute of Animal Physiology, Cambridge, UK. In the normal mammalian cloning procedure, an embryo is removed from a cow or sheep and divided into pieces; these pieces, when inserted into the uterus of a host mother, eventually result in genetically identical animals. The novelty in the recent Cambridge demonstration was the employment of two pairs of parents during early embryonic fusion. This innovation was achieved as follows:

- (1) A Frisian cow and a Hereford cow were artificially inseminated with semen from a bull of the same breed.
- (2) The two embryos were removed from the cows after a few cell divisions, when they consisted of 20 to 30 cells.
- (3) Each embryo was divided into four parts. These parts were put together in a culture, where they fused to form four mixed embryos.
- (4) The four mixed embryos were implanted, in pairs, into two host cows.

Four calves were born; one was pure Frisian, one was pure Hereford, and the other two calves contained cells from all four parents.

The two "chimerical" calves provide a most interesting genetic outcome. They are not crosses, in which there are combined some

genes from both breeds in every cell of their bodies; instead, every cell in their bodies is either pure Frisian or pure Hereford. According to the investigators, some of the most obvious gross manifestations are in the skin, where tiny patches of Frisian and Hereford distinctive color may be observed.

Quintuplet lamb clones also have been produced in the Cambridge laboratory. The experiments may lead to the successful growing of finer embryonic fragments; with present methods, division into more than four viable fragments is extremely difficult.

*N.A. Bond, Jr.*

ONR London

#### FINDING WATER LEAKS IN NEW CARS

A watertight way of detecting leaks in new cars means that dashboard drips and soggy carpets should become things of the past in new British Leyland (BL) cars.

Robot "sniffers" have been introduced on the assembly line at BL's Cowley, Oxford, UK, plant to spot potential water leaks. They will take the place of water spray tests, which BL has used in common with other car manufacturers.

The new system involves forcing a mixture of air and helium gas into the car as it nears the end of the production line. Robots with sensitive sniffers then scrutinize each seam, door and window seal to find out whether any of the gas mixture is escaping.

A leak is identified on a computer print-out for each car showing where rectification work is necessary. Hand-held sniffers then check that the work has been effective.

#### DOLPHIN SUMMER CAMPS-LET YOUR KIDS MIX ROBOTICS AND SAILING!

A flyer for Dolphin Summer Camps at Sevenoaks and Mill Hill, UK, has come to ONR London. For young people age 11 through 17, programs in fencing, photography, robotics, computing, riding, sailing "and many others" can be combined to form a unique holiday. The campers will be given an opportunity to "unwind the mysteries of film and video, and discover more about robots and computers..." They can pick and mix the ideal program, "in any one day you could find yourself arguing with a robot, directing your own video or animated film, or taking advantage of coaching in a wide range of sporting and outdoor activities."

All places at the camps have been subsidized by government and industry. Get to know the world of high technology at the remarkably low price of £70 (or \$120) a week!

What! No fracture mechanics for fun? No playing with polymer chemistry? No lazing with lasers? No statistics for starters?

*F.A. Richards*

ONR London

#### MATERIAL SCIENCES MEETING FOR THE RETIREMENT OF PROFESSOR N.J. PETCH, FRS, UNIVERSITY OF STRATHCLYDE, GLASGOW

A meeting on "The Yield, Flow and Fracture of Polycrystals" is to be held at the University of Strathclyde, 15-16 September, 1982, in honor of Professor N.J. Petch, FRS, who is retiring from the Chair of Metallurgy. The Chair was founded in 1886 and was held previously by such equally outstanding persons as Professors C.H. Desch and J.H. Andrew. The meeting has been organized by Dr. T.N. Baker, Department of Metallurgy, University of Strathclyde, telephone (Glasgow) 041-552-4400. The indications are that the meeting has been arranged in a relatively quiet manner so as to keep the audience small and informal; attendance is nearly fully booked. The intent is to publish the proceedings.

A tentative description of the meeting is as follows:

15 September -

Session I: Yield and Flow in Polycrystals;  
Chairman, Professor J. Nutting, University of Leeds.

R.W. Armstrong, ONR London - the yield and flow stress dependence on grain size.

N.J. Petch and E. de los Rios, University of Strathclyde - the deformation behavior of aluminum.

J. Gurland, Brown University - the plastic flow of two-phase alloys with coarse microstructures.

J.W. Hancock, University of Glasgow - the strength properties of porous materials.

Session II: Fracture of Polycrystalline Materials;

Chairmen, Professor D. Hull, University of Liverpool, and R.W. Armstrong.

J.F. Knott, University of Cambridge - microstructural aspects of fracturing processes.

J. Congleton, University of Newcastle Upon Tyne - crack branching during the fracturing of alumina.

Sir A.H. Cottrell, FRS, University of Cambridge - perspectives on the nature and importance of fracturing processes.

E. Smith, University of Manchester Institute of Science and Technology - strain localization at the crack tip.

16 September -

Session III: Applications of the Hall-Petch and Cottrell-Petch Relationships; Chairman, Professor G.W. Greenwood, University of Sheffield, and Professor K.H. Jack, FRS, University of Newcastle Upon Tyne.

- T. Gladman, British Steel Corporation, Swinden Laboratories, and F.B. Pickering, Polytechnic of Sheffield - role of grain size in determining the properties of steel.
- W.B. Morrison and R.C. Cochrane, British Steel Corporation, Teeside Laboratories, and B. Mintz, City University of London - development of low alloy, ferrite-pearlite steels.
- R.R. Preston, British Steel Corporation, Teeside Laboratories - effect of pearlite in structural steels.
- J.H. Woodhead, University of Sheffield - determination of the Hall-Petch constants.
- T.N. Baker, University of Strathclyde - microstructural features relating to the Hall-Petch friction stress.

**Discussion:**

- J.M. Gray and F. Heisterkamp, Niobium Products Limited.
- A.M. Sage, Highveld (Steel and Vanadium Corporation Limited).

Session IV: Flow and Grain Size Dependence of Non-Ferrous Metals and Alloys; Chairman, Professor N.J. Petch.

- N. Hansen, Risø National Laboratory, Denmark - Hall-Petch analysis for non-ferrous systems.
- J.D. Embury and H. Chandra-Holm, McMaster University - development of substructure in aluminum and aluminum alloys.

R.W. Armstrong

ONR London

CONFERENCE ON LIMIT THEOREMS IN PROBABILITY AND STATISTICS

The above conference was held at Veszprém, Hungary, from 20 to 26 June 1982. Approximately 120 people from the US, UK, FRG, France, and Holland and also from the USSR, Poland, East Germany, and Czechoslovakia attended, with the greatest number from Hungary, the host country.

The welcoming address was given by P. Revesz, who has been responsible for the organization of the meetings in the past. J. Durbin (UK) gave the opening lecture on approximations for boundary crossing probabilities for Gaussian processes. The approximations are applied to obtain percentiles for the Kolmogorov-Smirnov statistics when parameters are estimated and are also used to

solve problems in sequential analysis. Revesz talked on the approximation of local time of Brownian motion and of partial sums of independent, identically distributed random variables. Related results were discussed by E. Csaki and A. Földes (Mathematics Inst., Hungarian Academy of Sciences). The remarks of Revesz and other speakers emphasized the remarkable influence and power of the result on strong approximation of partial sums of independent, identically distributed random variables (with appropriate moments) by Brownian motion due to Komlos, Major and Tusnady (1975).

In a session on curve estimation, the author discussed smoothing spline estimates of regression functions. B. Silverman (UK) talked about his modification of the Good-Gaskins penalized likelihood estimates of density functions; rates of convergence and expected mean square rate of error are estimated. M. Csörgő (Canada) spoke about the total time on test in a nonparametric setting of a reliability question. A.V. Skorohod (USSR) discussed stochastic equations of complicated (possibly infinite dimensional) systems.

There was a session on probabilistic problems motivated in part by questions in statistical physics. P. Breuer (Hungary) described his work in collaboration with P. Major on central limit theorems for non-linear functions of Gaussian fields. D. Szasz discussed research on local limit theorems for random walks with internal states (i.e., random walks in a random environment).

C. Csörgő (Hungary) gave an interesting talk on empirical characteristic functions and some of their applications, e.g., to problems of statistical estimation. P. Deheuvels (France) discussed a strong approximation result for extreme values using in part the result of Komlos, Major and Tusnady. W. Phillips (US) presented material on the approximation of partial sums of Banach space valued random variables in the stationary strong mixing case by corresponding Gaussian partial sums.

The meeting provided a valuable forum and a congenial environment in which researchers from the East and West could meet and discuss topics of mutual interest.

One should also remark that there was a minute of silence in memory of J. Blum of the US, who expected to attend this meeting, but died about a month ago.

M. Rosenblatt

University of California

THE FIRST ARCTIC MODELING MEETING

A meeting was held at the Department of Applied Mathematics and Theoretical Physics, University of Cambridge (UK), 21-23 June 1982, to bring together modelers and observationalists concerned with the physical environment of the

Arctic basin and its margins. Twenty-eight scientists representing the U.S., Canada, UK, Norway, Sweden, Denmark, and France attended. The discussion of models included general and shelf circulation on various scales, ice growth and melt, upwelling, and frontal systems. The observational talks tended to emphasize variability and other factors that influence the design and corroboration of modeling efforts. The talks given are listed below.

Modeling of Arctic processes is in its early stages, except for sea ice, which has attained a relatively high degree of sophistication. Several approaches were discussed, ranging from simple to complex knowledge of the environment and considerable discussion was held on models, physical processes, and field programs. It was noted that parameterization schemes need to be developed and tested for the Arctic region.

The meeting was sponsored by the Scientific Commission for Ocean Research (SCOR) Working Group 58 and the Comité Arctique International. It was timely in that two large Arctic field programs are being planned for the near future: MIZEX and the Fram Strait Project. Similar meetings may be scheduled in the future on a biannual basis.

#### Attendees and subjects:

|  |  |  |   |
|--|--|--|---|
| P.D. Killworth<br>(DAMTP, Cambridge)               | A flawed model of the Arctic pycnocline.   | V. Squire<br>(Polar, Cambridge)  | Modeling of ice floe motions due to ocean waves.                                      |
| W.D. Hibler<br>(USA Cold Region Res.)              | On modeling seasonal and interannual fluctuations of Arctic Sea ice.                 | A. Semtner<br>(NCAR)   | Modeling the water masses of the Arctic Ocean and their relation to climate.          |
| J.J. O'Brien<br>(Tallahassee)                      | Long-term plans for modeling the marginal ice zone and adjacent ocean.               | J.-C Gascard<br>(L d'HN, Paris)  | Deep convection problems in general circulation models.                               |
| L.P. Roed<br>(Inst. for Geofysikk, Oslo)           | Ice-edge upwelling.  | D. Rothrock<br>(AIDJEX, Seattle)   | Ice motion and atmospheric pressure—basic data for studying air-sea-ice interactions. |
| K. Hunkins<br>(Lamont-Doherty)                     | The polar front in Fram Strait observed by helicopter CTD surveys in the springtime. | B. Rudels<br>(Bergen)  | Some implications of the YMER observations at 79°N.                                   |
| T. Vinje<br>(Norsk Polar-Institutt, Oslo)          | Special features in the Fram Strait area of importance to modelers.                  | L. Lewis<br>(FSRG, Sidney)   | Observations north of Spitzbergen, 1981.  |
| R. Bourke<br>(Naval Postgraduate School, Monterey) | Early winter observations of the polar front.  | P. Wadhams<br>(Scott Polar, Cambridge)   | Statistical properties of sea ice thickness distribution.                             |
|  |  | E.C. Carmack<br>(CCIW, Vancouver)  | Discussion of modeling problems in the Arctic.  |
|  |  | LCDR R.W. Booker<br>ONR London   |   |
|  |  | DR. ARMSTRONG APPOINTED VISITING PROFESSOR, UNIVERSITY OF STRATHCLYDE  |   |
|  |  | Dr. Ronald W. Armstrong, who recently arrived at ONR London as a Liaison Scientist in Materials, has been appointed Visiting Professor in the Department of Metallurgy, University of Strathclyde. The appointment extends until 30 September 1985, well beyond his expected tour in ONR London. |   |
|  |  | The appointment of Professor Armstrong indicates his recognition in the field of metallurgy and will enhance his value to the Navy as a liaison scientist.   |   |
|  |  | Dr. Armstrong is on leave from the University of Maryland.   |   |
|  |  | F.A. Richards<br>ONR London  |   |

**ONRL STAFF CHANGES**

In the past month we welcomed aboard liaison scientists Dr. David Mosher, Dr. Vivian Stannett, and Mr. Max N. Yoder. Dr. Mosher is a physicist from the Naval Research Laboratory, Washington, DC; Dr. Stannett is a chemist from North Carolina State University, Raleigh; and Mr. Yoder is a physicist from the Office of Naval Research, Arlington, Virginia.

**OBITUARY**

Dr. Edward I. Salkovitz, Director of Research Programs, ONR Arlington, died on 24 June. Condolences are extended to his wife, Suzanne and to their children, Daniel, Judith, and Lisa. Dr. Salkovitz had a long association with the Navy, beginning with his appointment to the Metallurgy Division of the Naval Research Laboratory in 1942. In 1959 he received the Navy Meritorious Civilian Service Award. He was Scientific Director of ONR London during 1970-1972. In 1982 he received the Washington Chapter of the American Society of Metals George Kimball Burgess Memorial Award for outstanding contributions to the field of metallurgy. Among the articles he wrote for ESN was "The Death of a Pioneer" (ESN 25-7:237 [1971] for Professor E.N. da C. Andrade, FRS, whose work in Materials Science Ed Salkovitz admired. There will be many friends and readers of ESN who will feel the same way about Ed.

R.W. Armstrong  
F.A. Richards

ONR London

**ONR COSPONSORED CONFERENCES**

ONR London can nominate two registration-free participants in the conferences it supports. Readers who are interested in such participation should contact the Chief Scientist, ONR London, as soon as possible.

NATO ASI on Numerical Taxonomy, Bad Windsheim, FRG, 4-16 July 1982.

1st Biennial National Atomic Spectroscopy Symposium, Sheffield, UK, 13-15 July 1982.

International Conference on Practical Bayesian Statistics, Cambridge, UK, 21-24 July 1982.

IXth IUPAC Symposium on Photochemistry, Univ. of Pau, France, 25-31 July 1982.

XI International Symposium on Mathematical Programming, Bonn, FRG, 23-27 August 1982.

4th Europhysical Topical Conference on Lattice Defects in Ionic Crystals, Dublin, Ireland, 30 August - 3 September 1982.

2nd International Workshop on "Ion Formation from Organic Solids II," Munster, Germany, 7-10 September 1982.

4th International Symposium on Gas Flow and Chemical Lasers, Stresa, Italy, 13-17 September 1982.

14th Europhysics Conference on Macromolecular Physics, "Polymer Crystals: Structure & Morphology," Vilafranca del Penedes, Spain, 21-24 September 1982.

EUROPEAN VISITORS TO THE US SUPPORTED BY ONR LONDON

| <u>Visitor</u>         | <u>Affiliation</u>  | <u>Navy Lab./Org. to be Visited</u>   |
|------------------------|---|---|
| Dr. L. Bengtsson       | ECMWF, Reading, Berks   | NEPRF, Monterey<br>(June or July)   |
| Dr. J. Cousins         | Propellants, Explosives, and Rocket Motor Establishment.<br>Westcott, Aylesbury, UK | NWC, China Lake,<br>(1 July 1982)<br>US Navy Consultant,<br>Inst. of Technology,<br>Pasadena, CA,<br>(28 June 1982) |
| Dr. Alon Gany          | Technion, Haifa, Israel   | NWC, China Lake<br>(15 September 1982)<br>NPS, Monterey<br>(17 September 1982)                                      |
| Prof. N.S. Kopeika     | Ben-Gurion Univ. of the Negev, Israel   | NOSC, San Diego<br>(August 1982)  |
| Prof. Dr. E.J. Neuhold | Institut für Infomatik,<br>Univ. of Stuttgart                                       | ONR (19 July 1982)<br>NSWC, White Oak<br>(20 July 1982)<br>NSWC, Dahlgren<br>(21 July 1982)                         |
| Dr. W.J. Stronge       | Univ. Engn. Dept.,<br>Cambridge, UK   | NRL<br>NWC, China Lake<br>NPS, Monterey<br>(Late June or early July)  |
| Dr. Eli Turkel         | School of Math. Science,<br>Tel Aviv Univ., Israel                                  | NEPRF, Monterey<br>(19-22 July 1982)  |

**ONRL REPORTS**

R-1-82

Area Report: Antenna and Propagation Related Work in Europe and Israel,  
by T. C. Cheston.

This is a report of visits made by the author to universities, industrial and other technical establishments while serving as a liaison scientist at ONR London from October 1979 to October 1981. The report begins by highlighting the most important topics, then goes on to describe research in France, Israel, Italy, The Netherlands, Switzerland, Turkey, West Germany, and Yugoslavia. A previous report covered activities in Denmark, Norway and Sweden.

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